The Influence of hybrid Communities of Practice on the development of teachers' technological, pedagogical and content knowledge

By

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DECLARATION

I, Lebohang Mahlo, declare that the contents of this dissertation represent my own unaided work, and that the dissertation has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

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ABSTRACT

Prior to and after the publication of the White Paper on e-Education (DoE, 2004), South African provincial governments launched several programmes to encourage the use of technology for teaching and learning in public schools, notably the provision of Teacher Professional Development (TPD) opportunities. The Western Cape Government (WCG) launched four major projects to expand the availability of technological resources in public schools over the period of two decades commencing in 2001 with the Khanya Project. Despite universal recognition of their importance by educators and scholars, current TPD programmes, such as those launched by the WCG, have come under increasing criticism for their inability to encourage the successful integration of technology into teachers' pedagogical practices. The result of this has been in-service teachers coming to depend on their informal Communities of Practice (CoPs) rather than WCG's TPDs to acquire the knowledge they need to integrate technology effectively into their pedagogical practices. The main aim of this study was to explore the influence of hybrid CoPs on the development of the participating primary school in-service teachers' TPACK. The theoretical basis for this study was the Community of Practice (CoP) social learning theory (Wenger, 1998), Strong and Weak Tie Theory (Granovetter, 1973), and the Technological, Pedagogical and Content Knowledge (TPACK) model (Mishra & Koehler, 2006). A qualitative research approach was used, which included 12 teachers who participated in open-ended survey questionnaires and one-on-one semi-structured interviews and observational sessions. Document analysis, specifically from WhatsApp group chat screenshots, was conducted across the sampled schools as part of the research approach. Additionally, the research incorporated one (*n=1*) school principal and two (*n=2*) deputy principals who actively contributed to all data collection modalities with the exception of the survey questionnaires. The findings showed the hybrid CoPs at these schools, to a limited extent, to have influenced the development of the participating in-service teachers' TPACK. For instance, as supported by the literature, to some extent these hybrid CoPs had influenced the learning of in-service teachers TPACK mainly through certain innovative approaches they adopted. These included mutual engagement fostered by teamwork and diverse roles; joint enterprise fostered by the establishment of common goals; and shared repertoire enabled by the use of communication tools and the sharing of teaching resources. Additionally, the findings showed that these hybrid CoPs influenced in-service teachers' TPACK learning through factors such as community, practice, meaning, and identity. A sense of community, fostered by

structures such as ICT committees within schools, motivated in-service teachers to actively participate in their hybrid CoPs, facilitating the exchange of TK. However, the community aspect was found to pose challenges, as some in-service teachers reported experiencing feelings of isolation and lacked confidence, potentially hindering their learning of TK, TPK, TCK and TPACK within these hybrid CoPs. Concerning practice, in-service teachers' dissatisfaction with school ICT rules and customs was hindering them from potentially learning TK, TPK, TCK and TPACK in these CoPs. Yet, when it came to problem-solving strategies, practice was found to serve as a driving factor and the possibility existed that this could lead to teachers' learning of TK and PK. These in-service teachers' repeated dialogues within their hybrid CoPs motivated them through the creation of a sense of meaning and this was likely to lead to some success in their acquisition of TK and TPK. In terms of identity, personal characteristics such as resistance to change, the literature showed this to be a possible constraint in the process of in-service teachers' developing their TK, TPK, TCK and TPACK. Notably, research has found that in-service teachers' sense of identity, shaped by the presence of new entrant teachers (newcomers) perceived as more knowledgeable in technology, serves as a motivating factor for their acquiring of TK, and the findings showed this to be the case in this study. Lastly, the findings showed that, to some extent, through bonding and bridging, in-service teachers had developed both strong and weak ties with each other during the COVID-19 pandemic's shutdown and partial school attendance, and this had resulted in the partial exchange of information which included CK and PK. In particular, the participant teachers gained more knowledge (CK and PK) through bridging as opposed to bonding, the latter resulting in the acquisition of CK only, it can be inferred that teachers' ties across all sampled schools were relatively weaker during the COVID-19 pandemic. From the findings, I developed the Community of Practice Teacher Technology Integration Model (CoPTTIM) with the aim of supporting in-service primary school teachers in acquiring the essential knowledge for effective teaching with technology. The CoPTTIM is specifically designed for use in schools, particularly primary schools, and particularly those located in historically disadvantaged regions. Its purpose is to enhance teachers' TK, TPK, TCK, and TPACK within the context of hybrid CoPs. The flexibility of the model enables the ongoing professional growth of teachers to persist, including during periods of isolation brought about by crises such as the COVID-19 pandemic. The South African government might benefit both from the findings of this study and the CoPTTIM, and these could assist government in redesigning and updating national ICT policies

such as the White Paper on e-Education (DoE, 2004) and in structuring more useful TPD programmes in ways that ensure that they occur organically and sustainably in teachers' employment contexts.

Keywords: Factors, hybrid Communities of Practice; innovative approaches; in-service teachers; Teacher Professional Development; ties, technology, TPACK.

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DEDICATION

This work is dedicated to three angels who, in their unique ways, saved my life.

To the mysterious man who saved my life more than 20 years ago. I am unable to recall the precise year because I was just a boy, but it has been over 20 years since that time. I had given up on fighting for survival when you materialised out of nowhere amid the ocean and carried me to your back. You rescued me from my sorrow, then you disappeared. I cannot pass a year without reflecting on that experience and, of course, expressing my gratitude for what you did for me. If I were not still alive, I never would have had the chance to write this dissertation. You are an angel. Wherever you may be, I hope this message conveys to you that the little boy whose life you saved over two decades ago is deeply grateful and will remain so indefinitely.

To my late father (stepfather) Wilson Mziwamakheswa Jodo. Even though I hate using the term "stepfather" to describe you, I feel compelled to do so to make it clear why I believe you to be an angel. This is because not all stepfathers are angels. I have always regarded you as an angel, even before your passing. My expression of gratitude to you does not intend to assume that life was perfect after you came into the picture. However, your presence in my life significantly eased my journey, making things much easier than I could have imagined. That is why I continue to regard you as an angel. I will always be grateful for the sacrifices you made, especially the financial troubles you had to go through to ensure I completed my first degree. I am confident that your spirit is watching over me, and I believe you still take pride in my achievements. I am still on the path to properly honour you in the way you deserve.

To my daughter. You came at the worst and darkest time of my adult life, June 2021. I was beginning to doubt God's existence. I was prepared to give up faith. Nevertheless, your birth in the initial days of June 2021 brought hope into my life, restoring my faith. Dear child, dear angel, through you I was able to pick up the pieces and continue with my journey to seek knowledge. Your birth instilled in me the belief that challenges only serve to make us stronger. You provided me with the purpose to persist in dreaming about success. Thank you. It is my sincere wish that one day this work will serve as a source of inspiration for you and that it will encourage you to pursue and continue with your educational path. You will always be my angel. I am also eternally thankful to your mother, particularly for her emotional support during that challenging period.

The dedication of this work extends beyond the three angels mentioned earlier. Its primary purpose is to be a source of motivation for every individual facing hopelessness, be it a child, young man, young woman, or adult on the verge of surrendering to poverty. Rather than letting poverty destroy our hopes, it should serve as a motivation to pursue education and aspire to success. Poverty, from this perspective, should be seen as a tool that strengthens us. To those feeling hopeless, it is my hope that this work serves as an inspiration, encouraging you to never stop dreaming.

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LIST OF ACRONYMS

Acronym	Full words
AI	Artificial Intelligence
CAPS	Curriculum and Assessment Policy Statement
CAQDAS	Computer assisted qualitative data analysis software
CK	Content knowledge
CoPs	Communities of Practice
CoPTTIM	Community of Practice Teacher Technology Integration Model
COVID-19	Coronavirus disease of 2019
CPUT	Cape Peninsula University of Technology
DoBE	Department of Basic Education
DoE	Department of Education
Email	electronic mail
FAL	First Additional Language
HL	Home Language
ICT	Information and Communication Technology
IR	Industrial Revolution
IT	Information Technology
LAN	Local Area Network

MCO	Maths curriculum online
MEED	Metropole East Education District
OECD	Organisation for Economic Cooperation and Development
PCK	Pedagogical Content Knowledge
PhD	Doctor of Philosophy
PK	Pedagogical Knowledge
RSA	Republic of South Africa
SAG	South African Government
SMS	Short Message Service
TALIS	Teaching and Learning International Survey
TB	Tuberculosis
TCK	Technological Content Knowledge
TK	Technological Knowledge
TPACK	Technological, Pedagogical, and Content Knowledge
TPD	Teacher Professional Development
TPK	Technological Pedagogical Knowledge
US	United States
WAN	Wide Area Networks
WAP	Wireless Access Points

WCED	Western Cape Education Department
WCG	Western Cape Government
WHO	World Health Organisation

Contents

GLOSSARY

Communities of Practice (CoPs): These are informal or formal groups established by in-service teachers within an organisation, who have the same interest in, or passion for, a subject and who enhance their knowledge and experience in this field by interacting regularly, whether they meet in person or online to provide opportunities for collective learning.

Hybrid CoPs: These constitute a method of meeting that mixes in-person and online interaction, albeit not always at the same time. For this study, hybrid CoPs are in-service teachers' informal or formal meetings taking place at various locations at various times. This means that every meeting session is asynchronous.

Information and communication technologies (ICT): Tools that can store, retrieve, manipulate, or transmit information electronically in a digital form.

Technology: ICT tools, software and hardware, used by teachers either for teaching and/or communication.

Innovative approaches: These are also known as dimensions of CoPs. They are key characteristics of a functioning and sustained CoP, and encompass mutual engagement, joint enterprise, and shared repertoire. A CoP is formed and sustained through these approaches.

Driving/motivating factors: These are factors that could serve as motivators for educators to acquire and develop important knowledge in their hybrid CoPs.

Constraints: These are factors that could hinder educators from acquiring important knowledge in their hybrid CoPs.

TPACK: This collective form of knowledge is an emerging type of knowledge that goes beyond a single focus on technology, content, or pedagogy, and instead considers the interplay between these three facets of teaching. It is a necessary knowledge for teachers to possess for them to teach effectively and successfully using technology.

TPD: This is the process of learning by teachers who intentionally or unintentionally engage in individual or collective, interactive or non-interactive, and instructive or self-directed activities

that enhance their professional development of knowledge and skills. This learning can be deliberate or implicit.

In-service teachers: Qualified teachers who have obtained their teaching degrees and are presently active in the teaching profession.

Public primary schools: The government is responsible for these schools and cover grades R through 7, belonging to the basic education sector in South Africa.

COVID-19: This virus is the causative agent of Coronavirus disease, an infectious respiratory illness.

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1. Introduction

The inspiration for this study was derived from my eight-year tenure (from 2015–2023) as a primary school teacher, teaching learners ranging from grade 4 to 7. My encounter with new technologies in the course of my teaching stimulated my desire to delve into educational technology and examine its implementation by educators for pedagogical purposes. While working as a primary school teacher, due to my enthusiasm and optimistic attitude towards educational technology, I frequently received requests from colleagues to provide solutions for computer-related issues and assist them in implementing diverse tools for teaching and learning purposes in their respective classrooms. As a result of possessing a significant level of expertise in the field, in 2017 until 2023, I was designated to serve on the Information and Communication Technology (ICT) committee of a primary school located in Khayelitsha, an area that has historically experienced socio-economic disadvantages within the Western Cape province of South Africa. This opportunity served as a motivation for me to introduce teachers who exhibit a fear or aversion towards computers in Khayelitsha to various technological skills that can be applied to pedagogical practices. During this period, I encouraged and demanded them to integrate these skills into their daily teaching routines. Khayelitsha is a manifestation of the developmental priorities that were pursued during the late-apartheid period, and as such, the region is classified as historically marginalised. Although Khayelitsha has its distinct history, politics, and geography, it shares many similarities with other previously disadvantaged townships in South Africa (Clark, 2018). There is a prevailing uniformity of conditions characterised by poverty, high levels of unemployment, and financially struggling schools (Clark, 2018).

The Western Cape Government (WCG) implemented the Khanya Project in 2001, the first major project in the Western Cape, which involved the introduction and deployment of technologies for educational purposes in township areas such as Khayelitsha in the Western Cape (Chigona & Chigona, 2010). However, numerous schools, particularly those situated in Khayelitsha, encounter difficulties in optimising their physical and human resources, as highlighted by Clark (2018). The findings of my two scholarly articles (Mahlo & Waghid, 2022; 2023) indicated that teachers

displayed an absence in the requisite knowledge and competencies necessary for technology-integrated pedagogy. Consequently, teachers relied extensively on their Communities of Practice (CoPs) to acquire technological knowledge and skills (Johnson, Bledsoe, Pilgrim & Lowery-Moore, 2019; Mahlo & Waghid, 2022; 2023; Mustikawati & Tarwiyah, 2022; Wang, 2020). This caught my interest in delving deeper into the impact of these CoPs on the development of primary school in-service teachers' Technological, Pedagogical, and Content Knowledge (TPACK). Mahlo and Waghid (2022; 2023), and Yildirim (2008) point out that CoPs hold significant value not only for educators as a means of acquiring knowledge, but also for learners as active participants in the learning process. Consistent with this claim Donner (2021) and Philip (2014) argued that the acquisition of knowledge by teachers through their participation in CoPs has been found to enhance their pedagogical approaches, resulting in more engaging and stimulating lessons for learners. For example, during my time as a primary school teacher, the integration of technology into my grade 4 classroom lessons elicited a sense of excitement and enthusiasm among my learners. If I had not incorporated technology, such as utilising YouTube videos, into my English lessons for an extended period, learners would implore me to exhibit YouTube videos displayed on the Smartboard. Additionally, I would use smartboards or interactive whiteboards in my lessons to encourage learners to participate in the solution of mathematical problems. Following the recommendations of De Vita, Verschaffel, and Elen (2014), for instance, I implemented a more interactive pedagogy in my classes with the goal of having learners actively engage in mathematical thinking processes such as problem framing and solving, pattern recognition, hypothesis testing, constraint analysis, abstraction, invention, explanation, and justification. This demonstrated that, through the use of technology, learners are engaged, enthusiastic, and most importantly, encouraged to have a positive outlook on their learning.

At most primary schools located in Khayelitsha, in the third decade of the 21st century, it has been observed, that most teachers are leading learners to designated computer laboratories. Within these facilities, learners are instructed on the utilisation of online educational programmes accessible through the computer systems. What is noteworthy is that the utilisation of these technologies results in increased learner engagement (Mahlo, 2020). The motivation levels of teachers are positively impacted by the support and encouragement they receive from their peers and principals. Thus, Thannimalai and Raman (2018) contend, from the findings of their study conducted in Malaysia, that principals assume a crucial responsibility in guaranteeing that teachers effectively

utilise available technologies. I have observed instances where my peers have taken the initiative to voluntarily arrange workshops for the acquisition of educational technology for other teachers, and I was among those peers who would be willing to offer my services as a trainer to fellow teachers. One of my ex-colleagues is frequently requested by nearby schools to provide training to teachers on the utilisation of technology for teaching and learning in schools around Khayelitsha. It can be asserted with confidence without the expertise acquired from CoPs, teachers would not be able to confidently incorporate technology into their classrooms. Insufficient utilisation of available technologies by teachers can result in learners being deprived of the opportunity to acquire technological skills (Mahlo, 2020) that are essential for employment, entrepreneurship, and tertiary education. Hence, it is imperative to acknowledge that these non-formal CoPs are advantageous not only to educators but also to the entire education system. Therefore, as advocated by Donner (2021) the CoPs of teachers deserve recognition as they play a crucial role in facilitating the utilisation of available technologies by both teachers and learners in their classrooms.

I located and framed this work within Wenger's social learning theory of Community of Practice (CoP) (Wenger, 1998), Granovetter's (1973) Strong and Weak Tie Theory, and Mishra and Koehler's (2006) Technological, Pedagogical, and Content Knowledge (TPACK). Lave and Wenger (1991) introduced the notion of "communities of practice" as a setting for essential learning, which Wenger solidified in 1998 and expanded on in his book *Communities of Practice: Learning, Meaning, and Identity* (Wenger, 1998). The necessity of exploiting social ties in the process of acquiring knowledge in a CoP is explained by the Strong and Weak Tie Theory (Granovetter, 1973), The TPACK model is one of the most important frameworks for integrating technology for pedagogical purposes (Mishra & Koehler, 2006). Theorists Wenger (1998), Granovetter (1973), and Mishra and Koehler (2006) drew me to a study of the influence of hybrid CoPs on the development of primary school in-service teachers' TPACK in a historically impoverished community, such as that of Khayelitsha. It is imperative to acknowledge that throughout the duration of the study, I remained cognisant of the prospective biases and constraints inherent in personal involvement within the research endeavour. Notably, an individual's emotional investment in a research endeavour has the capacity to exert influence over his/her decision-making processes. Consequently, I maintained vigilance regarding this aspect over the course of the study, and I embraced a reflexive approach as advocated by Holmes (2020) to navigate and address any potential biases stemming from personal involvement.

1.2. Background and Motivation

1.2.1. Introduction of technology and educational resources in apartheid and post-apartheid South Africa

During the 1980s, technology was implemented in South African schools, predominantly in private schools and certain adequately equipped public schools. Its main objective was to fulfil administrative functions such as managing student records, compiling examination results, generating learner reports, and scheduling timetables (Mdlongwa, 2012; Madoda, 2018). According to Hardman and Lilley (2020), while apartheid was in place, the curriculum was tightly regulated by the state and resources were distributed differently based on race. White learners were given more resources, both human and material, in schools than children of colour. Apartheid education's underlying pedagogics encouraged white children to have an advantage and perpetuated socio-economic inequalities for children of colour. After apartheid ended, the South African government set out to reform many aspects of society, including the educational system, in an effort to end the cycle of poverty and inequality (Hardman & Lilley, 2020). After South Africa's democratic transition in 1994, the Department of Education (DoE) announced the White Paper on e-Education (DoE, 2004), laying the groundwork for the growth of technological resources in South African schools, including the provision of TPD programmes and technological equipment primarily for teaching and learning. Prior to and following the publication of the White Paper on e-Education, provincial governments in South Africa implemented various initiatives aimed at encouraging in-service teachers to make use of technology in their teaching practice. These initiatives aimed to enhance their knowledge and foster the adoption of innovative pedagogical approaches by providing technological resources. Moreover, in order to address underperformance in school subjects, the South African government introduced technologies into schools to improve learners' outcomes at the turn of the 21st century (Hardman & Lilley, 2020). Over the course of two decades, the WCG initiated four ($n=4$) key initiatives to increase the availability of technological resources in public schools, including most schools situated in the township of Khayelitsha.

The Khanya Project was launched and implemented by the WCG in 2001 mainly to provide computer laboratories and TPD to all historically disadvantaged schools in the Western Cape. Ten years later, in 2012, the WCG introduced the Green Shoot programme with the primary goal of

using the existing Khanya computer laboratories to improve the teaching and learning of Mathematics in primary schools. The Click Foundation was then established concurrently with the Green Shoot programme to deliver online Mathematics and English literacy programmes and computers to primary schools in high-poverty level areas in South Africa (Click Foundation, n.d.). The WCG's recent intervention programme, the e-Learning Game Changer project (from 2016 to 2019) (Pinzie, 2019; WCG, 2019), was established to eliminate the imbalances between wealthy and historically disadvantaged schools. More specifically, its primary aim was to deliver Smart Classrooms and to implement TPD programmes to enhance teachers' capacities in teaching and learning (WCG, 2019; Pinzie, 2019). Despite two (*n=2*) of the four (*n=4*) interventions (Khanya and the e-Learning Game Changer projects) no longer being implemented in schools, all four (*n=4*) initiatives were premised on the notion of promoting the use of technology in teaching and learning in Western Cape public schools.

It's important to highlight that these four (*n=4*) initiatives have been or are being implemented across many schools in Khayelitsha. Given its status as a historically disadvantaged community, coupled with ongoing socio-economic and educational challenges, Khayelitsha often becomes a focal point for new educational endeavours aimed at enhancing the lives of children in the Western Cape. As of 2018, Khayelitsha falls under the jurisdiction of the Metropole East Education District (MEED), one of the four (*n=4*) districts in the Cape Town Metropole. A significant portion of the schools under MEED's purview are located in Khayelitsha: 35 primary schools, one (*n=1*) intermediate school, and 20 secondary schools (Clark, 2018: 26). Nevertheless, accessing schools in Khayelitsha can pose difficulties for learners due to various factors. This observation is supported by McKnight (2020), who contends that gang violence in certain areas of Cape Town has unfortunately impacted schooling due to safety concerns. McKnight (2020) further notes that protests have arisen due to numerous issues, including inadequate public school resources, which affect basic services and contribute to overcrowded classrooms. Occasionally, protests also address concerns about school safety. Challenges related to education are not limited to Khayelitsha residents; they also concern the wider community and government. For instance, Williams and Zacheous (2022) highlight that low-income regions like Khayelitsha in Cape Town persistently confront obstacles such as inadequate sanitation, water, electricity, and health issues including diarrhoea, dysentery, pneumonia, and tuberculosis (TB). Furthermore, these areas are vulnerable to social issues like crime, substance abuse, alcohol dependency, and prostitution. Efforts to tackle

these challenges in Khayelitsha have seen advancements in the provision of educational resources to schools, facilitated both by governmental efforts and partnerships with the private sector through initiatives mentioned earlier. Almost every classroom in the modern day incorporates some kind of technological instrument into their lesson plans. In the context of developing countries, as well, technological resources play a significant role in educational institutions (Hardman, 2019). Also, the South African government has managed through school-based technology projects like Gauteng online in the Gauteng province to work towards providing schools with infrastructure, digital equipment and preparing teachers for technology use in the classroom (Ndlovu, 2015).

1.2.2. Criticism and barriers to effective TPD programmes

Existing research emphasises the necessity for ongoing TPD programmes, indicating that teachers need to actively and continuously engage in TPD programmes to enhance their utilisation of technology and technology-related pedagogy for delivering subject matter effectively. The concept described above is apparent in a research study conducted by Esfijani and Zamani (2020), who posited that TPD programmes should give priority to collaborative endeavours, be continuous in nature, and regularly incorporate more effective face-to-face courses and workshops. This suggests that teachers should engage in specialised professional development programmes. Esfijani and Zamani's (2020) study, conducted in the Isfahan province, in Iran, indicates that, at least in the case of Iran, government TPD programmes may not be the sole solution for equipping teachers with the necessary knowledge to effectively teach in the contemporary digital age. The findings of Phillips (2014), from a case study conducted in Australia, showed one potential approach to equipping in-service teachers with the requisite knowledge (TPACK) for integrating technology into their teaching practices to involve workplace-based professional development initiatives.

Several studies (Chigona, 2013; Dlamini & Mbatha, 2018; Napal, Peñalva, & Mendióroz, 2018; Rana, Greenwood & Henderson, 2022) have further highlighted the importance of high-quality TPD programmes in providing in-service teachers with the essential knowledge to successfully incorporate technology into their pedagogies. Popova et al. (2022) asserted that those TPD approaches that combine content-area pedagogy and succeed in effectively integrating technology into teaching methods have shown the most significant impact on teachers' pedagogy. Popova et al. (2022) further add that teachers participating in such programmes need to have a thorough understanding of the essential elements related to their school subject(s), including

important facts, concepts, theories, and approaches. They need to have a solid grasp of the subject matter and be able to use an efficient teaching style, as described by Benson, Nwagbo, Ugwuanyi and Chinedu (2020). Koehler and Mishra (2005) argued that, to facilitate the successful integration of technology into the realm of teaching and learning, teachers need to possess TPACK.

However, despite the widespread acknowledgement of their value, existing TPD programmes in South Africa, such as those initiated in the Western Cape, have come under growing scrutiny for their inability to encourage the efficient blending of technology with teachers' pedagogical practices (Chigona, 2018; Chigona, 2015; Chigona & Chigona, 2010; Graham, Stols & Kap, 2020; Koranteng & Chigona, 2016; Mdingi, 2020; Sadeck, 2016). Although it is desired by the South African government (DoE, 2004) that teachers increase their technological knowledge and skills, demands of currently offered TPD programmes in regarding the use of technology in curriculum delivery are not currently being met in a meaningful, systematic and sustainable way. I argue that the South African government's approaches to TPDs on the use of technologies by teachers may be judged inadequate for several reasons. Ajani (2020), Dlamini and Mbatha (2018), Mahlo and Waghid (2022; 2023), Mdingi (2020), Sadeck (2016), Tiba (2018), Tiba and Condy (2021), Ubisi (2021), and Venketsamy and Zijing (2022) in their studies, which were all conducted in Western Cape respectively, found that TPD programmes were insufficient due to the WCG offering only a few training sessions to teachers. Chigona (2018) revealed that the quality of TPD programmes initiated by the Western Cape Education Department (WCED) for using technology in classrooms was compromised by their broad, general approach which made it difficult for teachers to teach specific topics using the appropriate technology.

It must be noted that this is not the issue only faced by Western Cape province, but other South African provinces as well. In a study conducted by Dlamini and Mbatha (2018), which involved 986 teachers from all provinces in South Africa, the results highlighted the necessity for in-service professional development programmes focused on utilising technology for teaching, teaching in diverse settings, and managing classrooms. The involvement of school management and administration in implementing and incorporating technological resources in education is also crucial. Furthermore, the study presented compelling evidence that despite the substantial expenditures made by the South African government in digital infrastructure, disparities in knowledge of technology among teachers persist. A research performed by Ajani (2020) in the

KwaZulu-Natal province revealed that teachers expressed dissatisfaction with the insufficient and inconsistent training and workshops they had participated in. According to them, the training and workshops were inadequate in addressing their specific classroom requirements and were scheduled in a way that disturbed their teaching activities. To put it another way, as argued by Chigona (2018), and Geldenhuys and Fataar (2021) what this indicates is that the TPD opportunities that teachers get may not be applicable to all of the subjects that teachers teach in school. Considering the potential of technology to enhance teaching and learning, teachers must possess the necessary knowledge in order to use it successfully in their teaching methods. This is the reason why teachers are increasingly depending on their CoPs (Mahlo & Waghid, 2022; 2023; Mustikawati & Tarwiyah, 2022; Wang, 2020; Yildirim, 2008), rather than government-organised training programmes, to acquire the knowledge essential for proficiently employing and integrating technological resources into their teaching practices.

1.2.3. The Need for Communities of Practice (CoPs)

Wenger (2011: 1) describes CoPs as "… groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly". The CoP environment is one that can give newcomers access to skills and knowledge while also allowing them to engage in personal and professional experiences that will enable them to integrate those skills and knowledge into their own identity and/or participation in society (Wenger, 1998: 214). There is a variety of possible methods that these groups might use to come together. According to Wenger (2011: 3), "some meet mainly face-to-face, some mostly online" and "some are formally recognised, often supported with a budget, and some are completely informal and even invisible". Brooks (2010) and Byington (2011) add that some may even meet using both face-to-face and online methods, and this approach is referred to as a hybrid CoP approach (Sumandiyar, Husain, Genggong, Nanda & Fachruddin, 2021).

According to previous studies (Saatçi, Rädle, Rintel, O'Hara & Klokmose, 2019; Grønbæk, Saatçi, Griggio & Klokmose, 2021) hybrid meetings often involve both co-located and remote participants simultaneously connecting through video or audio. This kind of meeting is a conference where some participants are physically present in the same space, while others participate virtually using technologies connected to the internet (Reed & Allen, 2022). According to Reed and Allen (2022), the outcome of this is that certain connections—such as those made via phone, video conference,

or both—involve face-to-face interaction. On the other hand, other authors have questioned this concept, arguing that blended learning and hybrid meetings are interchangeable terms. For instance, Neumayr, Saatci, Rintel, Klokmose, and Augstein (2021) contend that hybrid meetings can take place at the same time at several locations or at various locations at various times. A video conference or phone conversation are examples of synchronous distant communication that occur at the same time but in a separate location. However, an email can be sent and viewed at a later time for a meeting that is taking place at a different time and location, which is an example of an asynchronous meeting. Leaving a message on the kitchen table for another family member to read later would be an example of different time and same location (Neumayr et al., 2021). Beatty (2008) terms this approach "hybrid flexible." Hybrid-flexible is a method of meeting for course formats that mixes in-person and online learning, albeit not always at the same time (Eyal & Gil, 2022). Essentially, this means that every meeting session is available both synchronously and asynchronously. Members can pick a time and location for their meetings. The definition provided by Neumayr et al. (2021) challenges the idea that a hybrid meeting is merely one in which some participants meet in person and others virtually at the same time and in separate locations. A text or audio file that is provided to members, and may be read or listened to later, is sometimes referred to as a hybrid meeting or learning event. This method (hybrid-flexible) was chosen for the current study primarily because of its flexibility. The study conducted by Busher, James, Piela, and Palmer (2014) serves as an illustration of this type. According to their research, some students established study groups and virtual communities on Facebook to support or supplement their official learning in their courses, whether online or face-to-face.

Previous research suggests that specific approaches and practices used by educators may foster the development of CoPs. For instance, Akinyemi, Rembe, Shumba, and Adewumi (2019), Lecat, Spaltman, Beausaert, Raemdonck, and Kyndt (2020), and Qi and Wang (2018), all claim that teachers learn from one another, whether intentionally or unintentionally, through mutual support and teamwork. Wenger (1998) noted that members of a CoP undertake mutual engagement with one another and develop practice through the process of working together, checking, and disputing the meaning of what they are doing together. Similarly, Qi and Wang (2018) found that the formation of an online CoP among language teachers fostered collaborative engagement, with teamwork being particularly notable. This notion of mutual engagement, elucidated by Jho, Hong and Song (2016), involves sustained interaction among community members, leading to the

formation of roles and connections within the group. Lecat et al. (2019) emphasise the pivotal role of colleagues in refining teaching strategies, exploring innovative teaching approaches, and offering guidance to colleagues on teaching strategies. Additionally, Howlett, Arthur, and Ferreira (2016: 743) contend that while CoPs lack formal hierarchy or leadership, they do benefit from a champion who advocates for the community and encourages participation. In the educational context, Howlett et al. (2016) suggest that school principals and other teachers could assume this champion role, facilitating the adoption of technology by teachers and thereby fostering mutual engagement.

Research also shows that CoPs may also be formed through Joint enterprise. According to Mortier (2020), joint enterprise is the common objective that motivates members to engage and collaborate with one another. Teachers may utilise a common goal as a starting point to develop or solidify CoPs at work, as shown in research by Jho et al. (2016) and Phillips (2014). Jho et al. (2016) argue that this sharing of a common goal plays a critical role in inspiring members to interact and work with one another, and in turn, improves their own feeling of belonging to the group. Similarly, Mercieca (2016) believed that CoPs are voluntary groups of individuals who gather together because they have a shared interest or concern in investigating common problems, and because they wish to exchange ideas, and develop their practices. Bouhnik and Deshen (2014), as well as Byington (2011), highlight that CoPs may be enhanced and cultivated through shared repertoire using various communication platforms, such as email, wikis, discussion boards, chats, podcasts, blogs, Facebook chat, Twitter, YouTube, and WhatsApp, among others. Teachers may use these communication platforms to actively participate in online and/or hybrid CoPs to access professional development opportunities and acquire the kind of knowledge that can improve their teaching techniques in the classroom. As an example, a study conducted by Davis (2015) investigated the views of American in-service teachers on Twitter's potential as a professional development tool. Davis (2015) discovered that when teachers shared their knowledge and experiences and made connections with colleagues on the platform, this unintentionally and spontaneously, and in an organic way, led to the formation of a hybrid CoP. Furthermore, Wenger (2000) highlighted that as mutual interaction is maintained over time, members of a CoP develop a shared repertoire encompassing language, artifacts, tools, narratives, methodologies, and concepts. This assertion by Wenger (2000) is corroborated by the research conducted by Xu and Ko (2019), which revealed that mutual engagement facilitated the collaborative construction of a

shared repertoire among some teachers in Hong Kong. This shared repertoire revolved around the purposeful utilisation and dissemination of specific teaching resources and methodologies aimed at enhancing the teaching and learning process. The studies cited in this section show that educators have a key role in creating CoPs through teamwork, assuming varied roles in advocating for the integration of technology in teaching, common objectives amongst educators, and the sharing and use of communication technologies and teaching material.

While the innovative approaches outlined above can contribute to the establishment of hybrid CoPs, previous research also suggests that certain factors within a CoP have the potential to either motivate or hinder teachers from learning valuable information from their colleagues. Xu and Ko (2019) found that organising planned meetings among educators, such as for lesson preparation and final evaluation sessions, by means of reciprocal learning, served as a motivating factor for teachers' sharing of information in their CoPs. In a similar vein, Cotter, Leahy, McManus, Oldham and O'Sullivan (2017) highlighted the potential for staff members to engage in repeated dialogues through informal group meetings, a space where they can discuss their responsibilities, challenges, and opportunities for collaboration in a relaxed and non-demanding environment. These informal gatherings have the potential to foster the organic learning of teachers from one another in their CoPs. The existence of an ICT committee within schools, as noted by Vanderlinde, Dexter, and Van Braak (2011), along with educators' confidence, can greatly influence teachers' acquisition of valuable knowledge within their CoPs. Patton and Parker (2017) further suggest that as colleagues interact through discussions, thus diminishing isolation, a strengthened sense of confidence may emerge, eventually fostering a feeling of belonging to a community, and this may subsequently facilitate the recognition of the potential to become better teachers. A teacher's full confidence or lack thereof may either drive or hinder educators from learning valuable information from one another.

The practice of engaging in problem-solving strategies by educators may serve as a motivation for teachers' learning of TPACK related information. For instance, drawing from the social learning theory of CoPs, Batchelor (2020) and Cotter et al. (2017) observed CoP members engaging in idea exploration, discussing contexts and needs, and collaboratively resolving problems. Similarly, Holland (2018) asserts that a strong CoP is characterised by the development of collaborative practices among its members, empowering them to collectively devise problem-solving strategies

and effectively tackle practice-related challenges. However, on the other hand, in relation to practice, Dube, Nhamo, and Magonde (2018) point out, school management' rules around classroom technology use may either encourage or prevent teachers from learning valuable knowledge and expertise from one another. The availability of novice teachers who are more knowledgeable on the use of technology for teaching, may have a major impact on inspiring teachers in their endeavours to integrate technology effectively and meaningfully into their teaching. This assertion is elucidated in Phillips (2014), who characterises a CoP as a dynamic environment that not only affords newcomers access to expertise but also provides them with a distinctive participatory experience, allowing for the assimilation of newly acquired knowledge into their identity as active members of the community. Consequently, as asserted by Wenger (1998), the cultivation of a strong sense of identity among employees significantly enriches organisational learning. According to Phillips (2016), the growth of teachers' TPACK is shaped by both their identity development and practice. However, teachers' identity might hinder their ability to learn TPACK. According to Mathipa and Mukhari (2014), teachers' resistance to change and negative attitudes towards using technology in teaching are examples of obstacles at the teacher level that hinder their acquisition of technological knowledge and skills. This can result in teachers lacking a sense of identity in their CoPs.

1.2.4. Enhancing CoPs in education through the utilisation of online communication technologies

Following Wenger's influential research on the CoP framework, a new viewpoint has emerged by examining the interplay between communities and technology (Wenger, White & Smith, 2009). According to Wenger et al. (2009), certain CoPs engage in collective learning within integrated physical and digital environments. Furthermore, with the advancement of technology, numerous CoPs have exclusively emerged within digital environments. The position of a technology steward has emerged as a valuable component of and within CoPs that operate and whose participants acquire knowledge in digital environments (Byington, 2011; Donner, 2021). Qi and Wang (2018) argue that an online CoP has the potential to exhibit greater sustainability compared to a face-to-face CoP. The utilisation of social media platforms, for example, enables teachers to engage in both synchronous and asynchronous communication channels, and including both text and audio messages (Qi & Wang, 2018). This study conducted by Qi and Wang (2018), as part of a Chinese programme offered by an Australian university, highlights that these digital platforms facilitate

online meetings among teachers, providing them with the flexibility to connect through mobile devices at their convenience. For example, WeChat, just like WhatsApp, has a group platform feature that may facilitates seamless sharing of PowerPoint slides, pictures, and photos. Additionally, such social media platforms enable the instantaneous dissemination of online resources, including links and folders pertaining to teaching pedagogies. Qi and Wang (2018) further found that the mobile accessibility of WeChat, such as on smartphones and tablets, facilitated the teachers' ability to share repertoires without being restricted by temporal or spatial constraints.

Davis (2015), who researched American teachers' opinions of Twitter for professional development, argued that Twitter chats allow teachers to reflect on their own practices, to share what they've learned, and to network with colleagues. According to Davis (2015), teachers frequently expressed their appreciation for the sense of community and opportunities for learning provided by their online CoPs. The aforementioned studies (Davis, 2015; Lantz-Andersson et al., 2017; Qi & Wang, 2018) may have demonstrated limited efficacy in addressing the formation and utilisation of CoPs for the purpose of sharing instructional practices and facilitating the development TPACK among teachers. This limitation arises from their failure to acknowledge the existence of computer/technology phobia among certain teachers, resulting in their lack of ability and self-assurance to employ technology confidently and effectively in their teaching (Thang, Hall, Murugaiah & Azman, 2011). Thus, the possibility exists that the absence of in-person communication can hinder certain individuals from effectively and meaningfully participating in online group activities. This perspective is supported by Rademacher and Wang (2014), who contend that the technological aspects of social media, such as facilitating both real-time and delayed interaction, also give rise to teachers being apprehensive about its capacity to effectively convey emotions and foster sentiments of mutual exchange and trust. Essentially, critiques of the absence of in-person communication concluded that ties created and maintained online via social media were less supportive and beneficial than those created and maintained offline. The primary objective of this current study was to fill these gaps and to show how they may be bridged by teachers forming and employing hybrid CoPs. In contrast to a strictly online CoP, wherein all communication and collaboration occur exclusively through online channels, a hybrid CoP encompasses both online and offline interactions. The existing literature on hybrid CoPs consists of a limited number of studies, namely those conducted by Brooks (2010), Macia and Garcia

(2016), and Sumandiyar et al. (2021). However, these studies failed to investigate or assess the influence of hybrid CoPs on the development of teachers' TPACK. There is also a lack of empirical evidence regarding the examination of teachers' social connections when they share information within their hybrid CoPs. Social connections have been found to play a crucial role in facilitating effective knowledge exchange among teachers within their CoPs, thereby fostering positive relationships (Wenger, 1998).

1.2.5. The significance of online communication platforms in educational settings amidst the COVID-19 crisis.

The importance of online communication tools as a shared repertoire became evident during the recent COVID-19 pandemic, as demonstrated by educators' experiences of this mode of communication (Trust & Whalen, 2020). For instance, Okabe-Miyamoto, Durnell, Howell and Zizi (2021) observed a substantial increase in daily Zoom users. These increased rapidly from 10 million to 200 million per day in just four (*n=4*) months during the pandemic. Teachers predominantly utilised these conferencing tools for virtual classes with learners and to connect with colleagues, in a context of disruptions to traditional face-to-face education caused by the global pandemic (Tadesse & Muluye, 2020). The challenges caused by the COVID-19 pandemic, such as the separation of teachers from daily interactions and meetings, were discussed by Hargreaves (2021). Kim and Asbury (2020) also argued that the shift to distance education may have influenced teachers' professional identity by altering social ties between colleagues, a sentiment echoed by Glessner and Johnson (2020), who highlighted a distinct sense of disconnection within the education system in the absence of teachers' cooperation during the COVID-19 crisis. In contrast, Kim and Asbury (2020) discovered that the educators in their research placed great importance on their professional bonding and connections with other educators during the closure of schools due to COVID-19. Glessner and Johnson (2020) contend that special education teachers placed greater importance on building relationships through interpersonal communication with their colleagues during distance learning, leading to the formation of strong connections among these educators during the pandemic. Demir (2021) further explored the significance of ties, contending that for teachers to adopt a flexible and open attitude towards change, they should foster strong internal ties within their group alongside less intense external ties with teachers outside their immediate circle. Moreover, Demir (2021) suggested that teachers who forge strong social bonds with colleagues in their immediate vicinity, such as those

within the same team, subject, grade-level, or neighboring classrooms, should also foster and maintain connections with teachers from other CoPs or even different schools. Erickson (2004) and Lin (2001) further suggest that colleagues can cultivate weak ties with those from other institutions, facilitating bridging. This assertion is supported by Alwafi's (2021) findings, indicating that teachers appeared to foster weak connections while engaging virtually with other professionals on platforms like Twitter during the COVID-19 crisis. These previous studies highlight the significance of weak ties in facilitating the sharing and accessing of TPACK-related knowledge among teachers in hybrid CoPs during the COVID-19 pandemic.

Although social links between the different players may be tenuous, they do not necessarily pose a barrier to the exchange of information and ideas when supported by the available and appropriate technology (Valsta, Marstio, Pekkarinen & Mattila, 2021). Social media groups, such as those found on LinkedIn and Facebook platforms, represent the most notable instances of social networks within the educational domain (Valsta et al., 2021). Thus, there appeared to be a need to investigate the nature and extent of the support provided to the participant primary school in-service teachers' TPACK during the COVID-19 pandemic. According to the findings of Glessner and Johnson's (2020) United State (US) study, participant educators perceived an increase in collaborative efforts among their peers as a result of the COVID-19 pandemic, with online meeting platforms playing a significant role in facilitating these bonds. According to Sahlberg and Walker (2021), the likelihood of teachers maintaining their dedication to the profession is higher when they perceive themselves as valued by their peers and leaders, whom they view as trusted colleagues. Therefore, in this current study, by examining the relationships between the participant teachers, it was possible for me to determine how strong or weak the ties were between them during the COVID-19 pandemic. Moreover, a research gap also exists in exploring how the strength of ties influences the transfer of TPACK, specifically during the COVID-19 pandemic.

1.3. Rationale for the study

1.3.1. What is the nature of the problem to which this study responded?

Although technology is widely recognised by scholars as a potent enhancer of the teaching and learning process, a shortage of technologically and pedagogically skilled teachers, together with inadequate TPD programmes on the use of technology for teaching and learning has meant that

these technologies are often disregarded, resisted or underutilised. The discussion in this current study comes out of the assumption that the poor quality of TPD programmes is the major factor limiting the successful integration of technology into teaching. Nevertheless, I am cognisant of the fact that, ever since the dawn of educational technology and its incorporation into public schools in South Africa during the past twenty years (2001–2022), a number of scholars have pointed to specific causes as the impediments that prevent public school teachers from making effective and appropriate use of technology (Chisango & Lesame, 2019; Mwapwele, Marais, Dlamini & Van Biljon, 2019; Tiba, 2018). Education department and school ineffectiveness in formulating and enforcing policies, inadequate institutional support (Hart, 2023), historical inequities which include apartheid policies, underqualified educators, and inadequate allocation of resources in some regions (Dlamini & Mbatha, 2018), attitudes and resistance by certain teachers to change (Mwapwele et al., 2019; Spiteri & Rundgren, 2020), and other factors all contribute to this problem. The initial inadequate TPD programmes in South Africa have been found to have made little progress in terms of both encouraging and equipping teachers to integrate technology efficaciously into their teaching. It is for this reason that teachers are coming to increasingly rely on their CoPs (Mahlo & Waghid, 2022; 2023; Mustikawati & Tarwiyah, 2022; Wang, 2020; Yildirim, 2008), rather than on government-organised training programmes to acquire the knowledge they need for the effective use and integration of technological resources into their pedagogical practices. While hybrid CoPs have become increasingly prevalent in education, particularly during the recent COVID-19 pandemic and lock-down restrictions, according to my knowledge there is no evidence of studies that have been done to determine or measure their influence, particularly those CoPs used for sharing technology related knowledge for teaching and learning in South African public schools.

1.3.2. Why is this problem actual and relevant?

As mentioned earlier in this chapter, studies, such as those done by Bouhnik and Deshen (2014), Byington (2011), and Okabe-Miyamoto et al. (2021), show that CoPs may be developed and improved by a variety of technological tools. However, these studies fail to explore the effectiveness and preferences of teachers regarding these communication tools. Understanding which tools are found to be most conducive to knowledge sharing and learning within CoPs could guide the design of effective online collaborative platforms. A number of significant studies on the

influence of either face-to-face or online CoPs whose purpose was the development of teachers' TPACK have been carried out among school teachers in other countries. These have been done by Baya'a, Daher and Anabousy (2019), Coutinho and Lisbôa (2013), and Phillips (2014), respectively. However, for various reasons, in the current study, I argue that the results from these studies (Baya'a et al., 2019; Coutinho & Lisbôa, 2013; Donner, 2021; Phillips, 2014; Tyarakanita, 2021; Wang, 2020) are unsatisfactory for several reasons. Phillip's (2014) findings, for example, were based solely on the hypothesis that CoPs could help in explaining the processes that shape teachers' development of TPACK in their workplace contexts, rather than arguing that, in addition, CoPs (as defined by Wenger, 1998) could lead to the development of important knowledge. Since their CoPs were intentionally created for the purposes of their studies (Donner, 2021; Coutinho & Lisbôa, 2013; Phillips, 2014; Tyarakanita, Nurkamto & Drajati, 2021; Wang, 2020), conclusions from such studies may vary from those of the current research. Some of the small number of researchers who have investigated hybrid CoPs are Busher et al. (2014), Busher and James (2015), Byington (2011), Caudle (2013), Gaved and Mulholland (2005), Lynch (2015), and Macia and Garcia (2016). However, neither the hybrid CoP formation process in its natural context nor teachers' TPACK development is specifically investigated or evaluated in any of these research studies. What becomes apparent from all of this is the curiosity surrounding how hybrid CoPs influence the development of TPACK among primary school in-service teachers.

1.3.3. What is intended to be achieved with this research?

This current study delves into the innovative practices (approaches) that contributed to the unintentional formation of hybrid CoPs in public primary schools. Understanding how these hybrid CoPs emerge and evolve organically would provide valuable insights into the dynamics of teacher collaboration. Understanding the relationships between specific factors and their differential impact on TPACK can provide more targeted insights for educators and policymakers in their attempts to support teachers in their integration of technology in effective and meaningful ways. Thus, I argue that a research gap exists in the form of an exploration of whether and why certain factors have a differential impact on TPACK development. For example, are there specific driving factors that have a more pronounced effect on enhancing TPACK, and conversely, are certain constraints more detrimental to TPACK development than others? A research gap also exists in exploring how the strength of ties between teachers influences the transfer of TPACK, specifically

related to a period of the COVID-19 pandemic. Investigating whether strong ties result in more effective knowledge transfer compared to weak ties, and vice versa, can provide valuable insights into the dynamics of social relationships and their impact on teachers' learning outcomes in the context of TPACK development during times of crisis. My awareness of the dearth of research on hybrid CoPs in primary schools, prompted me to focus on the current study on the efficacy of existing hybrid CoPs in such schools. Middle and high school teachers have been the primary focus of most research studies (Baya'a et al., 2019; Cuddapah & Clayton, 2011; Goodyear & Casey, 2015; Goos & Bennison, 2008; Jho et al., 2016; Phillips, 2014; Sumandiyar et al., 2021; Trust & Whalen, 2020). Moreover, I considered it worthwhile to pursue a practical solution to the identified problem, as discussed below in section 1.4. This, I intended to do by proposing a technology integration model. A model that aims to enhance primary school teachers' TK, TPK, TCK, and TPACK within the context of hybrid CoPs.

1.4. Statement of the problem

The majority of teachers in the Western Cape, over the last two decades, have been found to struggle to integrate technology into their classrooms because of their limited knowledge and skills, and inadequate support from their school and district regarding the use of technology for pedagogical practices (Chigona, 2018; Chigona & Chigona, 2010; Geldenhuys & Fataar, 2021; Mahlo, 2020; Mdingi, 2020). Consequently, these teachers have come to rely on their informal CoPs as useful contexts for their professional development (Baya'a et al., 2019; Coutinho & Lisbôa, 2013; Donner, 2021; Ko, Lim, Joo & Resta, 2021; Phillips, 2014; Tyarakanita, Nurkamto & Drajati, 2021; Wang 2020). The problem of lack of knowledge and support poses a significant research challenge for various reasons. According to Thannimalai and Raman (2018), in the 21st century technology has the capacity to enhance the interactivity, engagement, and customisation of the learning experience. The absence of sufficient knowledge and skills required by teachers for them to effectively incorporate technology into their teaching can both impede learner engagement and restrict the potential for enhanced learning outcomes (Amusan, 2016). In light of this statement of the problem, the following research question served as the starting point for the development of this thesis:

How and to what extent are current hybrid CoPs being used in a sample of primary schools to influence the development of in-service teachers' TPACK?

The following sub-questions provide further context for the current study:

- What innovative approaches to form hybrid CoPs are being used by participant primary school in-service teachers in developing their TPACK?
- What are the driving factors and constraints around hybrid CoPs in developing the sampled group of primary school teachers' TPACK?
- What was the nature and degree of the strengths of these in-service teachers' relationships in their hybrid CoPs while they were in the process of learning TPACK from one another during the recent COVID-19 pandemic?
- In what specific ways could primary school teachers, such as those in the current study, be supported and assisted to build the knowledge required for their successful teaching with technology through their participation in hybrid CoPs?

These questions are further presented in Figure 1.1.

1.5. Aims and objectives

In this current study, the following is the primary aim:

This research aims to understand the influence of hybrid CoPs on the development of a sampled group of primary school in-service teachers' TPACK in a historically disadvantaged area of Khayelitsha in the Western Cape province of South Africa.

To accomplish the primary aim, the following objectives needed to be met:

- To understand the innovative approaches being applied by the participant primary school in-service teachers to form their hybrid CoPs in developing their TPACK.
- To understand the driving factors and constraints operating within the participant primary school in-service teachers' hybrid CoPs in the process of their attempts to develop their TPACK.

- To understand the nature and degree of the strengths of these in-service teachers' relationships in their hybrid CoPs in the course of their learning TPACK from one another during the recent COVID-19 pandemic.
- To develop a model, based on the findings, which might be used by other public primary schools to develop and support primary school in-service teachers' TPACK through their participation in hybrid CoPs.

1.6. Overview of research approach, design and methodology

The current study was firmly grounded in the interpretivism paradigm. This current study sought to better understand the influence of hybrid CoPs on the professional growth of selected primary school teachers in the specific contexts within which they work. Hence, I deemed it crucial to incorporate the interpretivism paradigm to gain an in depth understanding of the perspectives, experiences, and emotions of the participants. Interpretivism influenced the choice of tools used for the collection of data. The choice to use the Interpretivism paradigm for this research was driven by the aim of undertaking an in-depth study of the social experiences and viewpoints of the participants (Shah & Al-Bargi, 2013). Interpretivists tend to gather predominantly qualitative data from study participants over a prolonged duration, such as in the context of ethnographic and case study research (Dammak, 2015; Rehman & Alharthi, 2016). This research is a qualitative research study which uses an interpretivism paradigm. According to Fraenkel, Wallen and Hyun (2012), qualitative researchers are more concerned with the quality of a particular activity rather than with its frequency. The utilisation of qualitative research methodology facilitated me in conducting an in-depth exploration of the experiences of primary school in-service teachers regarding their sharing of TPACK within their respective school communities. The significance of the correlation between a qualitative research methodology and the investigation of individuals' understanding and interpretation of their experiences, as well as their practices, is elucidated by Grbich (2012), a correlation which is relevant to the current study. According to Askarzai and Unhelkar's (2017) assertion, the utilisation of a qualitative research methodology by a researcher is geared towards understanding the conduct of individuals and articulating what they have experienced. Given that the current research is interpretive in nature and aims to undertake an in-depth exploration of the influence of hybrid CoPs on the enhancement of TPACK among selected in-service teachers in three ($n=3$) public primary schools, a multiple case study research design was employed. Multiple

case studies were done with the purpose of understanding the diverse ways in which individuals encounter situations and how challenges could potentially impact practices across various locations (Compton-Lilly, 2012; Stake, 2005). When measured against a single-case study, a multiple-case study design offers both advantages and disadvantages, both of which I, the researcher, was aware. It is common for multiple-case studies to be seen as more convincing and reasonable in terms of drawing generalisations from their findings (Fraenkel et al., 2012). In terms of disadvantages, multiple-case studies often require a significant expenditure, not just in terms of monetary resources, but also of one's own personal time (Fraenkel, Wallen & Hyun, 2019). I committed adequate time to data gathering in order to be able to address some of the limitations, and one of the goals of this was to ensure that every case would be investigated in as much depth as was practically feasible.

1.6.1. Site selection

The current study was carried out in three (*n=3*) public primary schools purposively chosen from the MEED located in the Western Cape region. The sample chosen relates to a specific purpose: The three (*n=3*) schools were purposefully chosen based on having been assisted by the Khanya Project and the e-Learning Game Changer, both of which provided technological tools and training. Green Shoot was recently introduced by the WCG to all three (*n=3*) schools and online application tools were made available. The Click Foundation at the two (*n=3*) schools was implemented four years ago, in 2019. Most importantly, I considered these schools ideal for this current study as the principals of the schools confirmed in advance, before data collection, that teachers at the schools were collaborating in the use of technology for pedagogical practices, and that this was being done both in person and online. In other words, the three (*n=3*) schools were, at the time of the current study, also currently involved in hybrid CoPs, and involving all teachers.

1.6.2. Participant selection

In order to evaluate the influence of hybrid CoPs on teachers' TPACK development, this study involved 15 educators from three (*n=3*) public primary schools, five (*n=5*) educators comprising of four (*n=4*) teachers and one (*n=1*) principal or deputy principal in each school. They were selected to participate in this research with the intention of my and their assessing of their experiences with regard to the role and influence of hybrid CoPs on the development of their

TPACK. The aim was to purposively choose the most appropriate participants from the entire population based on their survey questionnaire responses on whether they were at the time of the study collaborating with other teachers regarding the use of technologies for teaching and learning. Creswell (2013) asserts that it is feasible to get a variety of viewpoints on the subject being examined, even with a limited number of participants. Hence, I deemed the inclusion of the 15 educators, which included a principal and two deputy principals, enough for this research. All participants satisfied the specified criteria, with the exception of the principals and deputies, who were purposefully chosen due to their roles as school leaders. I ensured that the participants included a varied range of teachers, I intentionally included recently graduated teachers who may have more technology skills compared to more experienced teachers who have been teaching for a longer period.

1.6.3. Data collection

This research included using several data-gathering tools, such as open-ended survey questionnaires, non-participant observation, and one-on-one semi-structured interviews. Moreover, the Interpretivist paradigm facilitated the understanding of social phenomena from the participants' viewpoints through the utilisation of these tools. The tools included the analysis of the participant teachers' WhatsApp group chat screenshots. Therefore, by using these various data collection tools, and including the analysis of WhatsApp screenshots from teacher group chats, the interpretivism paradigm provided opportunities for a better understanding of the influence of hybrid CoPs on the participant teachers' TPACK development. In this study, I employed open-ended survey questionnaires as a key qualitative data collection tool, following the methodology outlined by Ponto (2015). These surveys, as advocated by Jotforms Surveys (2022), are designed to be concise, containing a limited number of questions. Their primary purpose is to choose and recruit potential participants who are willing and suitable for inclusion in the study sample. It's important to highlight that, given the qualitative nature of this study, the responses gathered from the 12 participating teachers were also analysed alongside other qualitative data collection instruments.

1.6.4. Analysis of data

In the present study, I used both inductive and deductive approach. It is important to note that interpretivists employ an inductive approach to data analysis, rather than depending on deductive reasoning (Cohen et al., 2007). However, Zina (2014: 130) asserts that qualitative research methodology allows researchers to use both inductive and deductive reasoning, acknowledge subjectivity, include several views and realities, and to understand the impact of the study on both participants and the researcher. This technique of judiciously combining the two approaches allowed me to examine and appreciate the relationships, experiences, and perspectives of individual teachers and whole school communities as these related to TPACK development. I and other researchers consider that induction and deduction are both necessary to gain that rich and comprehensive knowledge, and that this provides the reason for giving equal weight to the two approaches, and why we discuss how they may both be used deliberately in the same study (Zina, 2014).

1.6.5. The criteria for appraisal

In this current study, to ensure trustworthiness, as suggested by Guba and Lincoln (1981), I addressed the issues of credibility, reliability, transferability, and confirmability. In this current study, I employed triangulation as a method to enhance the credibility and robustness of the findings. To ensure the transferability of the study, I provided a comprehensive overview of its purpose, my role as the researcher, the participants' perspectives, the rationale behind sample selection, and the research site. The methodological framework and the diverse range of strategies utilised in the study were outlined to establish dependability. Confirmability was maintained by meticulously documenting the research process using MS Word, including detailed records of all research meetings with supervisors, principals, and teachers from the three schools involved, ensuring transparency and consistency in decision-making throughout the study.

1.6.6. The researcher's positionality and bias

During the period of data collection for the current study I held a full-time teaching position at one of the three (n=3) schools where the data were gathered. It is noteworthy that all three ($n=3$) schools are situated within the Khayelitsha township, and this provided the benefit of reducing both travel-related expenses and time. Other advantages included easier access to the culture

(language, beliefs and customs) being studied (Sanghera & Thapar-Bjorkert, 2008), and the ability to ask more meaningful or insightful questions (due to possession of a priori knowledge). I felt more trusted than would a researcher who was not as familiar as I was with the 'culture' of the teachers and the learners at these schools, and, as a result, I believe I elicited more honest answers, and at the end, produced a more truthful, authentic and 'thick' description (Geertz, 1973 cited in Holmes, 2020). Consistent with Holmes (2020), the understanding of the culture made it easier for me to better understand the language, including informal language, and non-verbal cues. However, I was also aware of certain disadvantages linked to being a member of the population being studied. These include the possibility of my being inherently and unknowingly biased, that research participants may assume that because I am a member of their community, that I possess more or better insider knowledge than they do, and that their understandings, and mine are the same (which they may not be) (Naaeke, Kurylo, Grabowski, Linton & Radford, 2010). Holmes (2020) suggests that to counter these possible biases, a researcher should be both reflective and reflexive. Reflective and reflexive apply when a researcher spends some time thinking about how they are paradigmatically and philosophically positioned and make all efforts to be aware of how their positioning, and the fundamental, taken-for-granted assumptions they hold, might influence their research-related thinking in practice. The concept of positionality necessitates that the researcher acknowledges and permits the identification of their personal views, values, and beliefs regarding the research design, implementation, and outcomes. This practice is commonly referred to as the reflexive approach, as described by Holmes (2020). Reflexivity, as defined by Cohen et al. (2011), refers to the methodology employed by researchers to recognise and reveal their personal biases and involvement in their research, with the aim of their and others understanding the possible impact of these on the research. Thus, Masters and Doctor of Philosophy (PhD) student researchers in the social sciences are often required to explore and explain their positionality, as, in the social world, it is recognised that their ontological and epistemological beliefs influence their research (Holmes, 2020). Therefore, to counter subjectivity and bias in this current study, the following were done by me: verification and reliability checks were conducted with participants as well as with another student pursuing a Doctor of Education (DEd) degree; When it came to interviews and personal communication, I made sure that participants could check the transcripts; in addition, I ran the transcripts through a member check; I read and reread the interviews to make sure nothing was missing or misreported; and participants could fix any mistakes or ask if any parts needed to

be removed from the transcripts; to make matters more convenient, I also served as the interviewer for the study and had a prepared interviewer protocol that includes interview questions. To reduce bias, I was careful not to guide participants in specific directions during data collection. I am aware that participants need to be allowed to talk freely and that all answers should be recorded verbatim. I acted as a facilitator and, to the best of my ability, did not attempt to steer participants in any particular way. I interpreted data as the participants reported and did not allow the school's and participants' affiliation to affect how I understood the data. I did not allow my views of, nor feelings about, the schools to affect me or lead participants to respond in specific ways to questions. In other words, the participants were free to respond to the questions as they saw appropriate, with no intervention from me. I made every attempt to maintain neutrality in this regard. All the strategies employed in this current study are consistent with those advocated by Holmes (2020) who maintains that the concept of positionality necessitates that the researcher acknowledge and permit the identification of their personal views, values, and beliefs regarding the research design, implementation, and outcomes. Holmes (2020) further explains how an individual's values and beliefs can be influenced by such factors as political allegiance, religious faith, gender, sexuality, historical and geographical location, ethnicity, race, and social class, any or all of which may impact the perspectives of researchers.

1.6.7. Ethical considerations

In this study, ethical considerations were meticulously followed throughout the research process. Approval, as advocated by Flick (2007), was obtained from both the Ethics Committee of the Faculty of Education at Cape Peninsula University of Technology (CPUT) and the WCED, as evidenced in Appendices G and H. Additionally, permission (Appendix I) was sought from the school principals of the three ($n=3$) primary schools involved, allowing access to the populations. Consent forms (Appendix E) were provided to participants, outlining the study's purpose and their rights, with assurances of anonymity and the option to withdraw without harm. Participant identities were protected through the use of fictional names and the concealment of identifying information in WhatsApp screenshots. To safeguard data, including notes and recordings, they were stored in password-protected computer folders, ensuring exclusive access. Acknowledging my position as a teacher at one of the sample schools during data collection, I was mindful of the

potential for bias as an interviewer. To counteract this, participants were invited to flag any inaccuracies or request modifications in the interview transcripts to maintain fairness.

1.7. Significance and contribution of the study

This study uses a conceptual framework based on the three theoretical frameworks that are relevant to teachers' CoPs and their effective functioning as outlined in Chapter 2. No study has to date been conducted to investigate the specific ways in which these CoPs, particularly the hybrid ones, have the potential to influence educators' TPACK development. The current study aimed to fill this gap by exploring and evaluating the influence hybrid CoPs may have on the participant teachers' development of TPACK, and how these CoPs may contribute to the sustained development of the TPACK of primary school in-service teachers' other than those participating in the current study.

Firstly, the findings of this study guided me in developing a model called the Community of Practice Teacher Technology Integration Model (CoPTTIM) – see Chapter 7. The CoPTTIM has been specifically developed for application in educational settings, with a focus on primary schools, particularly those situated in historically marginalised areas. Its aim is to improve teachers' technological knowledge (TK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and TPACK in the setting of hybrid CoPs. I argue for this model being ideal for enhancing primary school in-service teachers' TPACK in their working environment (schools) without causing interference with their routine teaching duties. Moreover, government officials and national-level decision-makers may find this model of use in designing sustainable TPD programmes in such a way that they take place naturally and informally within schools, thus eliminating the necessity for teachers to leave their respective institutions for attendance at TPD or similar programmes. Given that the schools in this research are all located in the Khayelitsha area, it makes sense to pilot the model in a subset of primary schools in that area to begin with. However, the model might work in other historically disadvantaged areas in South Africa as well as in other countries.

Secondly, in a theoretical sense, the findings of this study may contribute to education researchers', educators' and policy makers' understandings of the various ways in which hybrid CoPs influence the development of teacher TPACK. The findings have the potential to contribute to the existing

knowledge base of the TPACK model since these findings may shed light on the hybrid CoPs' specific attributes that facilitate teachers' successful integration of technology into their pedagogical practices. Researchers may acquire a deeper understanding of how hybrid CoPs facilitate the exchange of information, foster collaboration, and foster the development of a professional community in disadvantaged contexts. The consideration of the study's findings may lead to potential theoretical advancements in the design and implementation of CoPs, in particular hybrid CoPs, with the aim of improving teachers' learning process of important knowledge necessary for effective teaching and learning in a technologically resourced classroom setting. Moreover, the current study's findings may promote debates about CoPs in general, hybrid CoPs in particular, which focus on whether and in what ways TPD opportunities inside schools need to be favourable to the establishment of the kind of hybrid CoPs that provide opportunities for teachers to come together both on- and off-line to solve pedagogical and other professional issues such as teachers' limited TPACK. By investigating the influence of hybrid CoPs on the development of teachers' TPACK, the study provides empirical evidence and practical insights that can inform and enrich the TPACK framework. The findings can help refine the understanding of how CoPs, hybrid CoPs in particular, contribute to the development of teachers' TPACK and highlight the specific knowledge and skills that are essential for effective technology integration in different contexts. The study's exploration of ways in which hybrid CoPs support teachers' professional development has implications for the CoP social learning theory itself. The study's findings have the potential to contribute to the advancement and implementation of the CoP social learning theory, specifically within the realm of technology-enhanced professional learning communities. Thirdly, it is hoped that the findings will help teachers, school leaders, and policymakers increase the use of technology in schools for pedagogical practice. In this way, the provincial governments would acquire the potential to gain benefits from the findings by utilising them to inform and facilitate the restructuring of TPD programmes in a manner that aligns naturally with the working contexts of teachers. Moreover, findings from this research could help shape educational policy and guide initiatives to better support teachers in historically disadvantaged communities in other parts of the world. Thus, I would advocate for policymakers to consider adopting innovative alternative approaches towards TPDs, this current study having demonstrated that hybrid CoPs have a strong potential to enhance teachers' TPACK.

While I recognise the significance of this study, it's essential to acknowledge that the research process was not devoid of challenges. Thus, it's pertinent to discuss these encountered challenges and the strategies I employed to overcome them. The level of trust established with gatekeepers, such as school principals, was crucial for gaining access to research participants. Despite some initial challenges, including schools already hosting student researchers, persuasion and direct communication facilitated access. The lack of response from potential participants posed further hurdles. To address this, survey questionnaires were hand-delivered to 89 in-service teachers, resulting in only 27 completed returns, and the 12 best suitable teachers were purposively chosen. Personal delivery aimed to overcome potential drawbacks of emailed surveys, such as low response rates. Challenges persisted in locating and scheduling interviews with chosen teachers, requiring intervention from deputy principals to ensure participation. Though effective, this approach caused delays in data collection.

1.8. Overview of the study

This dissertation is divided into seven chapters, as follows:

Chapter 1: Introduction and background

This chapter presents the study's research topic, introduction, background and motivation, and rationale. It gives a summary of the research problem that underlies the slow progress achieved in South Africa and in some other countries by TPDs in terms of both motivating and preparing teachers to incorporate technology into their teaching effectively. For this reason, teachers have come to depend primarily on their CoPs to achieve this. The research questions, aims, and objectives of the study are offered, along with a discussion of the study's potential original contribution and approach of the study. Lastly, the brief overview of the study is described and explained.

Chapter 2: Literature review

This chapter presents an extensive review of existing literature on the impact of TPD programmes locally and internationally. Also covered is the importance of technological resource initiatives in Western Cape schools. The past history and present situation of CoPs are explored, along with the impact of CoPs in schools, in particular the influence of online and hybrid CoPs. The knowledge

and skills required to teach using technology in the 21st century is explored. Finally, the impact of COVID-19 on education and on the formation of CoPs is discussed in depth.

Chapter 3: Theoretical frameworks

In this chapter, the conceptual framework created for this research study is outlined. The three theoretical frameworks that make up this conceptual framework are explained by the researcher: The CoP social learning theory (Wenger, 1998), the Strong and Weak Tie Theory (Granovetter, 1973), and the TPACK model (Mishra & Koehler, 2006). The conceptual framework emphasises the key concepts in the research study and illustrates how each concept connects to, and advances, the research aim and objectives.

Chapter 4: Research design and methodology

This chapter goes through the research paradigm used in this study, including the research approach, research design, research site and participant selection, and data collection methods, such as self-administered survey questionnaires, one-on-one interviews, non-participant observations, and document analysis of WhatsApp group chat screenshots. The study's trustworthiness, and the ethical implications are all discussed at length.

Chapter 5: Data analysis and findings of the study

The data analysis employs the computer application Atlas.ti, with the resulting findings closely tied to the study's sub-questions. Each sub-question's analysis and emerging themes are meticulously documented, recorded, and deliberated upon. These insights are then effectively integrated into the study's theoretical frameworks, enhancing comprehension and fostering academic dialogue.

Chapter 6: Discussion of findings

This chapter is developed from findings recorded in Chapter 5. It provides insights into the innovative approaches being applied by the participant primary school in-service teachers to form their hybrid CoPs in developing their TPACK. Also, this chapter discusses the driving factors and constraints operating within the participant primary school in-service teachers' hybrid CoPs in the process of their attempts to develop their TPACK. Lastly, the chapter provides insights into the

strength of these in-service teachers' relationships within their hybrid CoPs in the course of their learning TPACK from one another during the recent COVID-19 pandemic.

Chapter 7: Conclusions and recommendations

The research presentation wraps up by summarising the study and deriving conclusions from the findings. It also offers recommendations for enhancing the body of knowledge, introducing the new proposed (CoPTTIM). Furthermore, it provides recommendations for practical application, including principals, in-service teachers, and sustainable TPDs, as well as suggestions for policy adjustments, and it also offers limitations of the study. Lastly, it offers avenues for future research based on the findings.

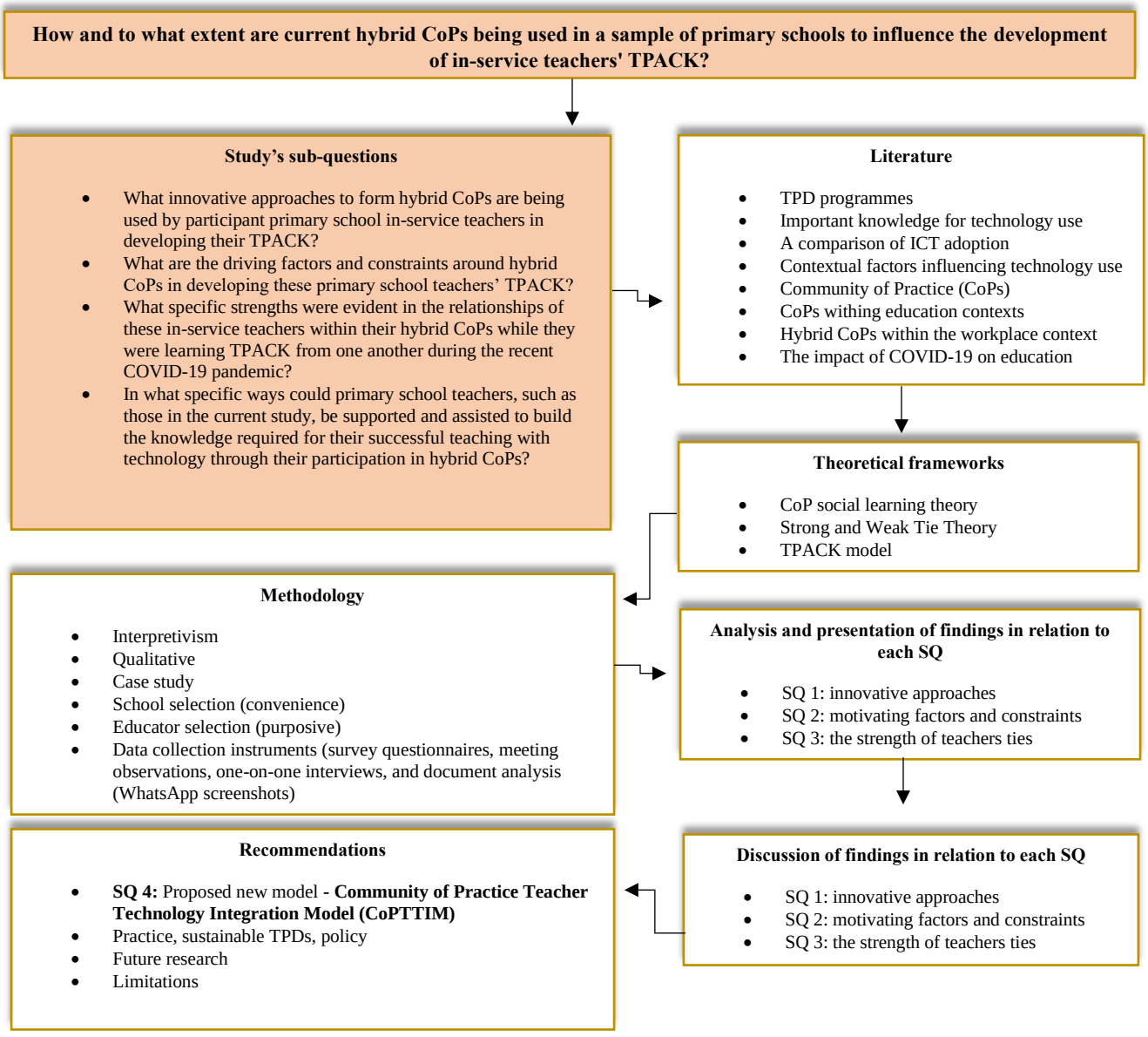

Figure 1.1: An overview of the research and indicates the current status of its progress

CHAPTER 2: LITERATURE REVIEW

Introduction

The previous chapter laid the groundwork for the aim of this research which is to examine the ways in which hybrid CoPs were influencing the professional growth of a sampled group of in-service primary school teachers in an historically disadvantaged area of Khayelitsha, in the Western Cape. This is a unique focus of this kind of research since, up to the present, there exists a dearth of research which specifically examines the potential of CoPs to enhance educators' TPACK. Furthermore, the existing literature does not provide any empirical proof of a specific research study that specifically investigates the development of teachers' TPACK within the context of hybrid CoPs. Hence, through an investigation of the influence of hybrid CoPs on the development of teachers' TPACK, this research aims to offer empirical evidence and valuable insights that can contribute to the advancement and enrichment of the TPACK framework, particularly in relation to TPDs occurring naturally and continuously inside the teachers' working environment (schools). In order to achieve the aim of the current study, it is essential to conduct a literature review of local and international studies that have examined teachers' technology knowledge and skills needed for pedagogical practices and how these are or not successfully acquired, and in which contexts. Included in the review are research studies conducted in educational settings similar to the setting selected for this current study. The literature review includes not only literature dealing with various educational organisations, but also, due to the general dearth of research on the topic, literature presenting research done on other types of organisations. The inclusion of literature pertaining to private institutions and corporations has facilitated a deeper understanding of the potential use of CoPs in enhancing workers' skills and knowledge. The literature in question has particular significance for the current study, as well as for studies undertaken in other educational contexts. This is due to the fact that workers within these organisations may encounter comparable challenges to those faced by educators, challenges such as their lack of technological skills and knowledge. This lack means that they too may depend on CoPs as a means of support and development. The existing body of research suggests that educators depend on their CoPs as a means of acquiring the skills and knowledge required to successfully carry out their teaching responsibilities. This reliance on CoPs stems from the perception that the TPD programmes offered by schools and districts are inadequate for meeting

their needs. For example, in the aftermath of educational technology's introduction, in the course of the last two decades provincial governments in South Africa have been at the forefront of supplying public schools with technology via a variety of government-sponsored projects (TPD programmes). However, the TPDs provided by these programmes have been considered insufficient by other scholars and educators for a number of reasons, the most significant of which is a lack of and/or nonexistence of follow up ICT training sessions and support (Popova et al., 2022). To that end, in the current study I felt it necessary to perform a literature review of previous studies to understand the research topic more in depth and in a broad/global context. I considered it was essential to learn about the specific ways in which CoPs contribute to the growth of teachers' knowledge, more specifically of their TPACK. This chapter has been broken down using the following headings and the symbols: Q1, Q2, and/or Q3, enclosed in brackets alongside each heading, indicate a subsidiary research question linked with the specific heading:

2.1. The impact of technological TPD programmes locally and internationally (Q1)

2.2. The knowledge and competencies required to teach effectively using technology in the 21st century (Q1)

2.3. A comparison of ICT adoption among schools throughout South Africa and Africa (Q1)

2.4. Technology resource projects in schools initiated by the WCG (Q1)

2.5. Contextual factors influencing teachers' engagement with technology for pedagogical purposes in the South African context (Q1 & Q2)

2.6. Background to the formation and functioning of CoPs) (Q2)

2.7. CoPs within educational contexts (Q1 & Q2)

2.8. Hybrid CoPs within workplace contexts (Q1)

2.9. Application tools used for communication in the workplace (Q1 & Q2)

2.10. The impact of COVID-19 on the global education system (Q1 & Q3)

2.11. Chapter summary

The topic under each heading is thoroughly investigated and discussed in line with the relevant literature.

2.1. The impact of technological TPD programmes in education

The literature shows that, on a global scale, both the adoption and integration of technology in teaching and learning have remained insufficient. This is despite the many unique advantages and the TPD initiatives that have been invested in schools by governments and corporate sectors around the world (Buabeng-Andoh, 2012). This phenomenon is evident in the study conducted by Khokhar, Gulab and Javaid (2017) among secondary school teachers in Pakistan. They contend that in developing nations, teachers often lack both the skills and the drive to incorporate technology effectively into their teaching practices. This deficiency arises from their inadequate preparation for utilising technology to enrich teaching and learning experiences. According to Buzuzi (2020), lack of training refers to the absence of formal training on how to successfully integrate technology for curriculum delivery, training offered at universities or other organisations that provide teacher training. Timotheou, Miliou, Dimitriadis, Sobrino, Giannoutsou, Cachia, Mones, and Ioannou (2023), as well as Tondeur, Krug, Bill, Smulders, and Zhu (2015), all delved into the utilisation of technology within educational contexts. The former conducted a literature review on studies conducted mostly in European contexts, while the latter conducted research in Kenya. Both studies highlighted the inadequate preparation of teachers for integrating technology into teaching and learning as a significant barrier to successful technology integration for curriculum delivery. Timotheou et al. (2023) further add that teachers' lack of ICT skills and familiarisation with technologies can become a constraint to the effective and meaningful use of technology in the classroom.

A similar situation exists in South Africa, where it has been shown in a number of studies that teachers have a tendency not to incorporate technology in their teaching due to a lack of TPDs on the use of technology for teaching and learning (Chigona, 2018; Dlamini & Mbatha, 2018; Graham et al., 2020; Hardman & Tshink, 2019; Koranteng & Chigona, 2016; Mahlo & Waghid, 2022; Mahlo & Waghid, 2023). I could disagree with this assertion since teachers' unwillingness and/or lack of confidence to take the initiative and engage in the easily accessible TPDs may be the problem rather than poorly prepared TPD programmes. For instance, Mapi, Dalvit, and Terzoli's (2008) study in South Africa revealed that some teachers did not feel the need to attend training

sessions because they simply did not wish to include technology in their teaching, irrespective of the level of their technological knowledge and skills. However, it is uncertain whether these disparities still exist, since these findings (Mapi et al., 2008) were based on data collected more than 15 years ago. On the other side, Tiba (2018) reports that purchasing expensive technology tools for the classroom does not guarantee their efficient use. Buckenmeyer (2010: 27) and Mahlo and Waghid (2023) make a similar point, arguing that the difficulty may not lie in acquiring the necessary technology for classroom usage, but rather in preparing in-service teachers to use it effectively. Dlamini and Mbatha (2018: 18) expand on this by arguing that meaningful and effective TPD activities need to accompany the supply of technological tools in order to transform education and enhance fundamental activities in the educational context. In turn, these exercises enable educators to expand and improve their technological and pedagogical expertise (Dlamini & Mbatha, 2018).

TPD, encompasses various on-the-job training methods, spanning from structured, lecture-based sessions to guidance and support through mentoring and coaching (Popova et al., 2022: 108). Oke and Fernandes (2020) have highlighted the relevance of preparing teachers for effective technology adoption, to keeping teachers up to speed with 21st century social changes and new requirements, particularly those linked to the expanding societal usage of technology. For instance, in a study carried out in Nepal by Rana et al. (2022), it was discovered that primary school teachers saw TPD programmes on technological use for teaching and learning as being essential to the success of any form of teaching and learning. According to the findings of a study carried out by Chigona (2018), in some South African schools located in the province of the Western Cape, in-service teachers believed that providing resources such as technological training for teachers to effectively deliver the curriculum could be the answer to in-service teachers' adoption and use of technologically resourced classrooms. A similar finding was made by Dlamini and Mbatha (2018) in their study of the ICT teacher TPD needs in South African schools. The authors of these studies (Chigona, 2018; Dlamini & Mbatha, 2018; Rana et al., 2022) all considered training in the use of technology for teaching and learning to be both an essential part of the pre-service teacher preparation that the in-service teacher participants had received and an integral part of the ongoing professional development in which they had participated while working as teachers.

Li, Yamaguchi, Sukhbaatar and Takada (2019), based on their study conducted in Mongolia, add that teachers may learn and improve their professional profiles through professional development programmes that allow them to observe, reflect, plan, and practice. Li et al. (2019) go on to identify six elements at the primary school level showing these teachers who had been observed to have improved over time thanks to the TPD courses offered by their government. The inclusion in these programmes of skills and practices in educational technology usage, professional competence in educational technology use, cooperation with technology integration initiatives, the many advantages of using technology, freedom to create, professional recognition, and professional standing were all stated by Li et al. (2019) as crucial to teachers' abilities in using, and willingness to use technology in their classrooms. As much as I concur with Li et al. (2019), their study falls short of comprehensive recognition of the importance of TPACK among teachers. The findings of their study would have been more convincing had the authors used the TPACK framework, as supported by Miguel-Revilla, Martínez-Ferreira and Sánchez-Agustí (2020). These researchers, who contend that TPACK-focused training has the potential to encourage successful technology integration in curricular delivery share this viewpoint.

There is no doubt that TPD demands concerning the use of technology for curriculum delivery are not met in a meaningful and systematic manner, despite the desire by teachers to increase their technological knowledge and skills. Studies highlighted thus far indicate a need for continuous TPDs, which suggests that teachers need to actively participate in a process of TPDs to measurably and meaningfully improve their use of technology in curriculum delivery. This notion is evident in a study conducted by Esfijani and Zamani (2020) who argued that TPDs, to be meaningful and successful, should prioritise collaboration, be ongoing, and should routinely include more efficient in-person courses and workshops. Despite some intriguing empirical evidence in favour of persistent engagement over a considerable length of time, and the shunning of quick, one-time workshops, Desimone (2009) argues that there is no theoretical agreement for how extensive a period training should be in terms of time. Contrarily, Yoon, Duncan, Lee, Scarloss, and Shapley (2007), in a narrative review of previous studies conducted in the US, echoed the importance of sustained follow-up TPD. Their study indicated that TPD programmes characterised by substantial contact hours (ranging from 30 to 100 hours in total) and spread over six to twelve months were more successful in enhancing teachers' ability to improve learners' academic performance compared to shorter, one-off programmes. The importance of longer TPD programmes was later

supported by Vilppu, Södervik, Postareff and Murtonen (2019), who argue that TPD programmes that extend over time have more positive behavioural outcomes than one-time events. Vilppu et al. (2019) found successful professional development programmes to be collaborative, reflective and of long duration. Instead of being isolated workshops, the programmes are tightly integrated into everyday teaching practice.

While some of the research studies in this field —especially those from South Africa—have stressed the significance of continuous TPD for teachers, there have been no studies showing a beneficial effect of such training on teachers' use of technology for delivering curriculum. I am cognisant of the fact that it is difficult to assess or measure the efficacy of TPD courses in the Western Cape, given that so few in-service teachers receive follow-up training. Similar sentiments are expressed by Popova et al. (2022), who claim that in-school follow-up assistance, and time allowed for teachers to practice with other teachers, are less prevalent among large-scale TPD schemes. Most importantly, the studies that have been discussed so far have been based on formal training programmes that have been made available for pre- or in-service teachers. These programmes have failed to take into account the potential role of so-called "informal trainings" that are occurring naturally within school contexts at the same time as teachers are performing their daily duties. As per the definition given by Lecat et al. (2020), informal learning or training refers to teachers acquiring new skills and knowledge through intentional or unintentional participation in individual or collective activities. These activities can be interactive or non-interactive and can involve instruction or self-direction. The purpose of such learning is to enhance teachers' professional development in terms of knowledge and skills. Learning may occur via explicit or implicit means. These activities include a range of actions, including as contemplating, perusing, engaging and cooperating with peers, providing and getting feedback, and exchanging experiences and ideas (Lecat et al., 2020). This definition is close to that of Schei and Nerbø (2015) who maintained that the end goal of informal collaborative learning is to obtain new skills and professional knowledge. Lecat, Raemdonck, Beausaert, and März (2019) examined primary and secondary school teachers' professional development through informal learning activities and the reasons participant teachers gave for undertaking these informal learning activities. The results showed the prominent role played by direct colleagues in this process, mostly in refining their teaching, to acquire new teaching approaches or to find advice for class management. Jurasaite-Harbison (2009) emphasises that a CoP, and the interaction between individuals within that CoP,

constitutes a valuable and enriching working environment and acts as a motivator for engaging in informal learning. In this current study I intend to investigate the results of the in-school follow-up assistance provided by in-service teachers, working together in their school contexts, to utilise technology to deliver curriculum. Considering this, the following section focuses on the abilities and knowledge teachers need to use technology effectively in their classrooms.

2.2. Teachers' knowledge as vital for teaching with technology

Teachers' knowledge can be defined as, "the whole of knowledge and insights that underlie teachers' actions in practice'' (Verloop Van Driel & Meijer, 2001: 446). Fennema and Franke (1992) argued that a teacher's knowledge plays a significant role in shaping classroom practices and, by extension, in learning outcomes (Rohaan, Taconis & Jochems, 2012). As new learning tools are developed, there is a growing need to determine the specific sorts of knowledge educators need to properly integrate this knowledge and the accompanying tools into their lesson plans (Koehler & Mishra, 2005). This claim is backed by the arguments of Rohaan et al. (2012), who note that it is often accepted that a teacher's level of expert knowledge of technology education has a significant influence on the technology learning of learners. Thus, it is not desirable for governments and schools to invest excessive amounts of money in current technology if teachers lack the knowledge to properly use it and integrate it, as argued by Koehler, Mishra, Kereluik, Shin, and Graham (2014) and Graham et al. (2020). Educators need adequate technological, pedagogical, and content knowledge (TPACK) to effectively integrate technology into their lessons, as outlined by Koehler and Mishra (2005) and Koehler et al. (2014). Multiple studies, including those of Chigona (2018), and Shilenge and Ramaila (2020), advocate TPACK as necessary for teachers to possess in order for them to teach effectively and successfully using technology. However, this does not seem to be the case everywhere in classrooms, including South African classrooms.

According to Shulman (1987 cited by Amusan, 2016), competent educators should also have sufficient pedagogical skills. These include the concepts and tactics of classroom management and organisation, and 'topic knowledge', which is the educators' background knowledge in the subject(s) they teach. A teacher is putting good pedagogy into practice when they select methods of teaching that work well for the learners they teach. This is also known as "content pedagogy" (Benson et al., 2020: 14702). Studying how Smart Classrooms have affected the pedagogy of grade

11 teachers in Gauteng Province, Mugani (2020) found that the participant teachers who were using the Smart Classroom technology knew their subjects well and by using smartboards, were able to confidently explain and deliver these subjects to learners in accordance with their lesson plans, suggesting that the teachers had a firm grasp of the subject they were covering. However, in a related study, Spaull and Kotze (2015) discovered that 79% of South African Grade 6 Mathematics teachers lacked expertise in basic mathematical topics, and this made it difficult for them to teach the more difficult concepts. Additionally, many of these teachers didn't even finish the required Mathematics curriculum. Even though it appears immediately obvious, there are a variety of potential reasons why the findings and recommendations from these two research studies (Mugani, 2020) disagree or contradict each other. For instance, Mnguni's (2020) study is based on information gathered from teachers teaching many topics/subjects as part of a TPD project in a high school setting, whereas Spaull and Kotze's (2015) conclusions were based on information from Mathematics teachers within in primary school setting. Therefore, it may be argued that the conclusions from these two studies cannot be applied to one similar setting, and that the small sample sizes for both of these studies and many others represent a significant constraint. By engaging all four (*n=4*) prior and ongoing TPD initiatives in the three public primary schools of the Western Cape, as well as Mathematics and language teachers, I expected in the current study to address this gap. All of the research studies and reviews mentioned in this section, taken together, however, implies that it is crucial for teachers to have in-depth understanding of the subjects they teach. Teachers should have a solid understanding of the subject matter they teach, which includes being knowledgeable about the underlying concepts, ideas, theories, and methodologies related to the subject at hand. This view is in line with the emphasis Benson et al. (2020) place on a strong teaching model needing to go hand in hand with knowledge of the subject.

Pedagogical skills include any methods a teacher might use to improve the quality of their lessons in the classroom (Benson et al., 2020). These methods, and a sound knowledge of them and experience in their use, are helpful for educators because they provide for more room for learners to personalise their understanding of a particular content. These pedagogical skills include, but are not limited to, set induction, stimulus modification, nonverbal communication, inquiry, and reinforcement, to name a few (Benson et al., 2020: 14702). These definitions therefore indicate that teaching effectively requires the use of sound pedagogical techniques to ensure that learners are engaged and paying attention to what they are being taught. This notion is consistent with

research from the Organisation for Economic Cooperation and Development (OECD, 2017), which found that the use of trusted instructional abilities can improve learners' informational literacy and cognitive performance. Furthermore, Benson et al. (2020) contend that a teacher's pedagogical skills may increase learners' interest in a topic, keep them actively engaged in the learning process, nurture the development of their skills, keep them focused on their work, and improve classroom interaction. Therefore, I contend that, in order to ensure that learners are meeting a variety of learning goals, teachers should use a broad range of strategies, activities, and resources (Eby, as cited in Okpala & Ellis, 2005; Amusan, 2016). Hardman (2019) supports this assertion, concluding in her research that employing technology may improve learner success in Mathematics, depending on the pedagogical approaches utilised by teachers. In other words, the extent to which ICTs can do this is determined by how a technology is utilised as a learning/teaching tool, or how it influences pedagogical practices (Hardman, 2019). Technology on its own appears to have no significant impact on student's attainment. Moreover, with the help of their pedagogical knowledge, teachers create lessons that help learners understand the subject matter and develop a positive mindset towards it. Thus, it may be crucial to modify or adapt the learning content so that it is suitable for the learners' level of comfort with participating in the class learning activity. In addition, according to research conducted by Masek, Suhadi, Sidek, and Ismail (2019), educators who use technology to convey theoretical aspects of a technical topic have a high degree of pedagogical competence. In agreement with this statement, I argue that, in order to design their lesson plans, teachers have turned to the internet as a source of research material. This implies that in-service teachers need to take specialised courses in professional development. It has come to my attention that there has not been much research on how teachers acquire TPACK in the workplace, which in this case is a school context, given the studies that have been mentioned in the chapter up to this point. The present study did not concentrate only on how in-service teachers grow their TPACK; it also looked at how teachers use their newfound knowledge in the same setting in which they first came to acquire it. More specifically, there is no investigation of extant proof of a thorough investigation of informal TPACK acquisition in South African schools. Thus, as has been mentioned the goal of this study was to try to close this research gap. The earlier studies described here also demonstrates how teachers might utilise TPACK to maximise the usage of technology in the classroom. However, previous research has not gone any deeper into the various specific ways in which teachers learned how to use technology in their practice. I would

argue that, when implementing TPD initiatives, care should be taken to ensure that teachers are prepared to use a variety of technologies rather than just one. Thus, in the following section I make a comprehensive comparison between the WCG's ICT initiatives and alternative approaches in other regions or countries.

2.3. A comparison of ICT adoption in schools throughout South Africa and Africa

Since its inception in 2004, there does not seem to have been much progress toward implementation of the national White Paper 7 on e-Education policy (DoE, 2004). The lack of a comprehensive national strategy for implementation is glaringly obvious. White Paper 7 (DoE, 2004) was delegated to each of South Africa's nine provincial education departments by the national DoE. The collective response from the nine provinces took the form of a drive to bring actual technological tools into schools. Several ICT pilot projects were launched by the provinces in the early days of ICT integration in South African schools. ICT encompasses a wide range of technologies that facilitate the manipulation and transmission of data. These include, but not limited to, media for storing data (paper records, CDs, DVDs, flash drives, etc.), methods for disseminating data (radio, television), and tools for interacting with visual and auditory content (microphones, cameras, loudspeakers, telephones, cellular phones, etc.). Computers, servers, mainframes, and networked storage are all part of this category. Personal devices, such as mobile phones and MP3 players, are also considered personal hardware. Application software, ranging from simple spreadsheets made at home to complex enterprise packages and online software services, is also included. Finally, the hardware and software required to operate transmission networks, which can be anything from a home network to a large enterprise package, are all included in this category (Elen, Clarebout, Sarfo, Philippus, Pöysä-Tarhonen & Stassens, 2010: 228). The province of Western Cape, along with the rest of South Africa, has been working to improve the quality of education by encouraging the use of ICT for pedagogical purposes. However, financial and infrastructural limitations, together with resource imbalances have led to inconsistent development in this field among South African provinces and other nations (Dlamini & Mbatha, 2018). There is an extensive variety of ICT integration in schools throughout the provinces. The White Paper states that the provinces of Western Cape (Khanya), Gauteng (Gauteng Online), and Northern Cape (Connectivity Project) have made significant progress with provincial

implementation. All of these initiatives were established by the government in collaborations with the private sector to provide ICT-based resources, in theory, to all schools.

Although technology has been successfully incorporated into several schools in the urban areas of South Africa, it is unfortunate that the same level of integration has not been achieved in rural schools (Lembani, Gunter, Breines & Dalu, 2020). The advent of digital technology has resulted in a distinct disparity in educational opportunities between rural schools and those in urban areas. According to Lembani et al. (2020), a significant number of rural schools continue to lack access to technological resources, thus impeding the integration of ICT into the pedagogical practices of these teachers. Furthermore, teachers in these schools have not received enough professional training to effectively incorporate ICT into their classes (Lembani et al., 2020). According to the research conducted by Mahlo and Waghid (2022), the implementation of educational technology in South African state schools has been ongoing for the past 27 years. However, numerous scholars have identified certain factors that pose significant challenges for teachers when it comes to incorporating these technologies into their classrooms (Barakabitze, William-Andey, Ainea, Mkwizu, Maziku, Matofali, Iddi & Sanga, 2019). When comparing South Africa to more developed counties, it becomes evident that the country has had difficulties in effectively integrating ICT efforts into its educational institutions. According to Hu, Gong, Lai, and Leung (2018), there is a tendency for developed countries to have access to more substantial financial allocations, better infrastructure, and more extensive policies whose purpose is the incorporation of technology into their educational systems.

In a similar vein, it is worth noting that the integration of ICTs into the educational systems of numerous African countries has encountered challenges due to limited progress and uptake. This can be attributed to the absence of robust ICT policies, inadequate long-term infrastructure support encompassing electricity, internet connectivity, software, and hardware devices, as well as an insufficiency of both teacher capacity and financial resources (Barakabitze et al., 2019). In comparison to some African countries, South Africa has shown a significantly higher level of progress in the implementation of ICT projects within the realm of education (Barakabitze et al., 2019; Telecom Review Africa, 2023). Nevertheless, it is noteworthy to mention that certain African countries, like Tanzania, Kenya, Rwanda, and Uganda, have achieved substantial advancements in the incorporation of technology in educational institutions. These countries have

used mobile technology and online learning platforms effectively as tools for educational integration (Barakabitze et al., 2019). It is also noteworthy that African governments exhibit an intense desire for the use of technologies as a way of positioning themselves at the forefront of technological advancements. The private sector in African countries, including that in South Africa, also exhibits a strong interest in making investments in areas where corporations see possible future development opportunities within ICT in education. The following section provides an overview of historical and present ICT initiatives in the Western Cape that align with the implementation strategy outlined in the White Paper on e-Education (DoE, 2004).

2.4. Key Past and Current ICT Initiatives Supporting the Adoption of ICT in Schools in the Western Cape

As mentioned in the previous chapter, the WCED and the private sector have undertaken numerous projects to ensure the use of ICTs by teachers and learners in public schools in the province, most notably the Khanya Project, the Green Shoots initiative, the Click Foundation, and the e-Learning Game Changer project, each of which is discussed briefly below:

2.4.1. Khanya Project

Established in 2001 and running until 2011, the Khanya Project set out to provide Western Cape public schools with computer laboratories and in-service teacher training on the use of educational technology (Chigona, 2018; Chigona & Chigona, 2010; Mahlo, 2020; Mdingi & Chigona, 2021). The goal of the initiative was to improve learner achievement and decrease teaching load by incorporating technological tools into the curriculum initially at 853 schools (Hardman & Tshink, 2019) most of which were in disadvantaged communities (Hardman & Lilley, 2020). Schools were given software programmes like CAMI Maths and Master Maths to improve mathematical education at their school (Hardman & Tshink, 2019). Among the performance support tools described by Clarebout and Elen (2006), CAMI Maths is one that helps learners solve problems by carrying out algorithmic operations on their behalf. Lessons involving higher-order cognitive activities might in this way receive greater attention from learners. According to one study conducted in 2007 (Isaacs, 2007 cited in Tiba, Condy & Tunjera, 2016), by that year, 70% of Western Cape learners and 70% of their teachers had access to technology in the classroom. Starting in 2001, the initiative helped establish 35,000 computers in public school computer labs

around the province, and over 26,000 educators received pedagogical technological training between 2001 and 2012 (Sadeck, 2016: 7).

According to Chigona, Chigona, and Davids (2010) and Mooketsi and Chigona (2016), the WCG had hoped that all of the province's teachers would be able to effectively incorporate technology into their teaching practices by the year 2012. However, Chigona (2018) noted that many teachers were not sufficiently digitally competent to integrate technology and pedagogy in their classrooms even after the Khanya era and felt more comfortable utilising technology only for basic MS Word and Excel. Possible reasons for the project's failure to achieve its goals include inadequate training on basic technical issues, training that focused on a single type of technology (e.g., desktop, laptop, or desktop computer), and training that excluded specific teachers based on the subjects they taught (Mooketsi & Chigona, 2016; Sadeck, 2016). Louw, Muller, and Tredoux (2008) present a different view, suggesting that the Khanya Project did have a beneficial influence on learner outcomes, but that the degree of the effect was dependent on the pedagogy used and the amount of time learners spent using the computers.

The Khanya project's apparent failure to give teachers adequate preparation for employing technology in the classroom may be traced back to the initiative's emphasis on learners rather than educators, as has also been suggested by Louw et al. (2008). Because of this, I contend that if teachers had been the project's main emphasis, perhaps more of them would have been equipped with this kind of knowledge to ensure that the technology would be used to enhance their teaching, in addition, and inextricably linked, to their learners' learning experiences. In turn, this would have ensured that the teachers had the enduring skills and knowledge required to teach in a digitally equipped classroom. The Khanya project had to be included in the present study since historically it is the first project of its kind to be launched in South African schools following the declaration of democracy. Additionally, Mahlo and Waghid (2022: 2023) point out that schools may only have, or have had, one or two computer laboratories, and this may have forced learners and teachers to share these, resulting in limited use of these resources.

2.4.2. Green Shoots

Green Shoots was initiated by the WCED in 2012 (Green Shoots, 2019). The project's objective was to enhance primary school Mathematics teaching and learning by providing online tools

(Hardman & Tshink, 2019) that make use of the Khanya labs already in place (Green Shoots, 2019). By the end of April 2022, this initiative was set to have been completed in 742 schools, involving a total of 354 714 learners and 8478 teachers (Green Shoots, 2019). The project aims to contribute to the quality of Mathematics teaching, developing teachers' pedagogical content knowledge and capacities to use data to improve teaching and learning strategies; to improve learners' attitude and engagement in Mathematics, and develop their ability to set goals and work towards achieving these in the subject; to raise learners' Mathematics attainment in terms of the number of learners passing Mathematics in all grades; and to impact the culture in schools and the education department, to make data informed decisions that positively impact teaching and learning practices at school and district levels (Tarling, 2018). The following are the Green Shoots online application tools:

- Maths Curriculum Online (MCO), a weekly Mathematics exercise programme aligned with the Mathematics Curriculum and Assessment Policy Statement (CAPS).
- MCO – SBA (School Based Assessment), an online assessment programme for MCO users.
- Maths At Home (M@H), an online after-school programme for grades 3–7.
- Maths Quest (MQ), a CAPS-aligned Mathematics exercise programme available in senior phase; and
- GSTEACH, a series of self-paced courses for teachers on the use and integration of the Green Shoots Suite (Green Shoots, 2019).

Dr. Isabel Tarling compiled a report on the results of the Green Shoots initiative for the University of Cape Town (UCT). The data was collected via the use of structured questionnaires, as well as semi-structured interviews with officials from the school system, administrators, and focus groups consisting of educators and students. Tarling (2018) offers information that cannot be disputed: all of the goals and objectives that were established for the project were more than adequately accomplished. There is evidence that the initiative improved the quality of Mathematics instruction and learning in schools, and the proof comes from data collected via questionnaires and interviews

with teachers, as well as from principals and district officials (Tarling, 2018). The teachers learned how to evaluate the data that was created by the learners using MCO in order to detect learning gaps in entire classes or in potential learners, to identify areas in which learners were experiencing difficulty (Tarling, 2018). Through their involvement in the project, teachers gained better confidence in their conceptual understanding and pedagogical expertise, as well as increasing their pedagogical content knowledge and interest in Mathematics (Tarling, 2018).

The main problem with these Tarling's (2018) conclusions is that the researcher relied excessively and solely on surveys and interviews to gather data, omitting the fact that seeing teachers use MCO *in situ* would have improved the reliability of the findings. The data gathering tools utilised in Tarling's study exhibit a few well-known drawbacks, including the potential for participant bias or dishonesty when answering questions put to them by the researcher. Therefore, if the researcher had also used the observation approach, the results could have been more intriguing and of greater value. The researcher's assertion that the study's conclusions cannot be contested because all the project's aims and objectives were more than satisfactorily met seems over ambitious. I tend to disagree with her assertion because no further research has been done to back it up; once again, credibility is at issue. Another research on MCO might be conducted to confirm or refute Tarling's (2018) findings, an acceptable strategy to address this constraint. The goal of the current study was to fill such a gap. Although the Green Shoots project has not yet been the subject of published study, Hardman and Tshink (2019) note that there is anecdotal evidence from the project's website that the participating schools are indeed enhancing their learners' mathematical skills. In spite of the fact that Hardman and Tshink (2019) and Tarling (2018) have investigated the success of the Green Shoots initiative, it is important to acknowledge that there is a noticeable gap in the literature in terms of critiquing the Green Shoots initiative. As a result of this gap, it may appear that I have placed an excessive amount of reliance on Tarling (2018) for data on the Green Shoots initiative in this current study.

2.4.3. The Click Foundation

The Click Foundation was founded in 2012 (Click Foundation, n.d.) in collaboration with the WCED to offer online English literacy programmes and computers to primary schools in poorer areas in South Africa (Click Foundation, n.d.). Among the online learning programmes offered by the foundation are Reading Eggspress, which assists learners in developing their English

comprehension skills; Matific, an online primary school Mathematics resource; and Reflective learning (Michael & Susan Dell Foundation, 2022). Primary school teachers may use these effective techniques to assist learners in developing the five literacy abilities necessary for reading mastery: phonemic awareness, phonics, vocabulary, fluency, and comprehension (Michael & Susan Dell Foundation, 2022). The programmes are designed to attract and stimulate learners by using an enjoyable mix of games, music, and prizes as they navigate the platform on their own. The foundation's effect so far includes technology training offered to principals, teachers, and facilitators (NASCEE, 2022), an improvement of 10% in learners' English comprehension, and the benefit of ICT resources to 85,900 learners and 173 schools around the nation (Click Foundation, n.d.). This data is sourced from the project's website, and it remains uncertain if there is continuous monitoring and assistance provided to educators. Moreover, It must be noted that there is no evidence of a study that has investigated the impact of the Click Foundation. Even though Click Foundation places more of an emphasis on learners than on teachers, teachers need to be able to use these technologies as well in order for learning to go smoothly and productively. It would thus be fascinating to find out whether and/or how teachers learn TPACK in their hybrid CoPs and specific ways in which they connect to, and use this for, the learners' online learning programmes offered by the Click Foundation.

2.4.4. The e-Learning Game Changer

The WCED's most recent ICT effort, the e-Learning Game Changer, was launched in 2015 (RSA, 2015), but was only intended to run as a full-cale project from 2016 to 2019. Its overall goal was to enhance teaching and learning by using technological tools in the classroom, with a particular emphasis on Mathematics and languages in Western Cape primary and secondary schools (Pinzie, 2019; WCG, n.d.). It was during the four years operation of the project that 6421 Smart Classrooms were installed in a variety of schools throughout the Western Cape province (Pinzie, 2019: 47). Smart Classrooms are classrooms equipped with digital resources, such as computers, Smart Boards, and projectors that are wirelessly networked (WCG, 2019). Additionally, 1160 computer laboratories have since been updated, and 705 new subject/projected information technology labs have been built (WCG, n.d.). Over 2000 educators took part in professional development ICT training sessions held on weekends and after school (Pinzie, 2019). Despite the ambition on the part of the WCG to see ICT become a "game changer" in the South African

educational system, the pace of integration in certain schools has been slower than anticipated (Munje & Jita, 2020).

In 2019, a grand sum of 28,871 tablets found their way into diverse public schools, encompassing both primary and secondary levels, across the Western Cape. This initiative was complemented by the establishment of 6422 Smart classrooms and the setup or enhancement of 1160 IT laboratories (Mahlo, 2020; WCG, 2020). Additionally, it was projected by the Western Cape Government (WCG) that approximately 1273 public schools in the region would have seamless connectivity to fully operational Wide Area Networks (WANs) by the close of 2018 (WCG, n.d.). At the beginning of 2019, around 333 schools were connected to Local Area Network (LAN) connections (WCG, 2019). So far, the WCG has deployed over 945 Wireless Access Points (WAP) in schools (WCG, 2019). In addition, the WCG created an e-learning site that provides, and will continue to provide, a variety of curriculum material, resources, e-books, activities, courses, and digital documents to learners, educators, parents, administration, and members of school governing bodies (Brand South Africa, 2015; Mahlo, 2020). More than 12,000 curricular-relevant digital materials may be found on the e-learning platform (WCG, 2019). Through WCED, the WCG is providing resources to help schools throughout the province adopt and use technology. In contrast to the Khanya Project, the WCG's e-Learning Game Changer project aimed to familiarise both educators and learners with, and equip them to, make effective use of a wide range of technology, including, but not limited to, Smartboards/Interactive whiteboard, laptops, wireless projectors, visualizers, and eBeams (Mahlo, 2020). In terms of technology, an interactive whiteboard consists of a computer connected to a data projector and a large, touch-sensitive board that shows the picture from the computer and lets users directly input and manipulate it with their fingertips or styli. With the included software, you, as a learner and teacher, can do more with your computer with a touch of a screen (Smith, Higgins, Wall & Miller, 2005 cited by De Vita et al., 2014: 1).

The purpose of using four TPD projects was, of course, to get an accurate image of where things were at the time in terms of teachers' knowledge and the results of these programmes. It is certain that the WCG has excelled in its mission to equip schools with a range of the latest technology. In other words, the WCG is not lacking in technology and professional development initiatives. However, there appear to be deficiencies in the goals of ICT projects carried out in schools in the Western Cape. For instance, these projects tend to concentrate on either Mathematics or language

subjects. This observation was supported more than ten years ago by Perryman, Ball, Maguire, and Braun (2011) in their research, from whose findings they argued that English and Mathematics departments appeared at the time to be receiving more attention compared to other subjects. This preference could be attributed to the fact that these subjects were and are studied by the entire school cohort and due to the traditional/historical emphasis placed on literacy and numeracy. Another observable shortcoming of these projects seems to be the narrow focus of the Western Cape and private donors on the physical deployment of technology for curriculum delivery implementation rather than on properly integrating technology into the school curriculum. This point of view is shared by Li, Yamaguchi, and Takada (2018), who note that, while teachers may have easy access to technological tools, many lack the knowledge to successfully incorporate them into the lessons they teach. Through the Khanya project, Green Shoots, Click Foundation, or the most recent e-Learning Game Changer initiative, there does not seem to be evidence of the development of a critical mass towards the adoption and use of technology. Furthermore, it does not appear that the installation and deployment of technologies and services are coordinated. Different technology is being distributed to different schools, but there is no obvious educational strategy behind the effort. As a result, little is known about the pedagogical use of technology by teachers in the Western Cape.

There is a concerted attempt to find new methods of professional development for teachers because of the widespread discontent with existing forms of in-service training such as those TPDs initiated by the WCG. Collaboration models like the one proposed by Wenger (1998) and Yildirim (2008) see CoPs as important, or often the sole sites of learning since it is within these that knowledge is produced and disseminated. CoPs have been found to show potential for successful professional development since they provide chances for colleagues to share their own experiences in the workplace, learn from one other's perspectives, and ultimately improve as a unit. Thus, many teachers depend heavily on their CoPs (Yildirim, 2008) to obtain the information essential for the successful use and integration of technological resources in their pedagogical practices, while TPD programmes have been found in the literature to have a relatively little influence on the teachers' acquisition of the technological knowledge they need for teaching in the 21st century.

2.5. Contextual factors influencing teachers' engagement with technology for pedagogical purposes in the South African context.

There exist significant factors that may either hinder or promote the effective utilisation of technological resources by teachers within classroom settings. These contextual factors, in conjunction with the inadequacy of TPD programmes, lack of teacher knowledge (Ojo & Adu, 2018), specifically TPACK (Dlamini, 2022), encompass the absence of policy and planning (Ojo & Adu, 2018), insufficient institutional support (Dlamini & Mbatha, 2018; Mathipa & Mukhari, 2014; Ojo & Adu, 2018), historical disparities (Dlamini & Mbatha, 2018), and constraints associated with teachers' un favourable attitudes towards technology in curriculum implementation (Dlamini, 2022; Mathipa & Mukhari, 2014; Dube et al., 2018; Umugiraneza, Bansilal & North, 2018). These are discussed in detail under this section.

2.5.1. Inadequate policy planning and implementation in primary schools

According to the ICT policy established by the National Department of Education in South Africa, the White Paper on e-Education (DoE, 2004), the integration of technology throughout the curriculum is deemed essential for the purpose of facilitating new methods of information gathering and analysis for both learners and educators. The intention of this integration is to enhance and elevate the quality of teaching and learning across all schools in South Africa (DoE, 2004). Numerous schools, have, with the help of provincial departments, particularly those situated in urban settings, since 2004, integrated computer technology into their infrastructure. Additionally, certain educators have undergone specialised training to effectively incorporate technology-enhanced learning into their curricula (Ojo & Adu, 2018). However, these technologies appear to date to not be used effectively. In the study conducted by Mathipa and Mukhari (2014), it was found that certain primary school teachers in some townships in Gauteng reported that the laboratory facilities were consistently inaccessible during school hours. Additionally, these teachers noted the absence of ICT policies in their respective schools, resulting in a lack of obligation for teachers to incorporate and utilise technologies in their pedagogical approaches. Mathipa and Mukhari (2014) identified poor leadership at the school level and the lack of an ICT policy as contributing factors that hinder the adoption of technology in many of the sampled schools. Consistent with Mathipa and Mukhari (2014), the findings of Munje and Jita (2020) suggest that the lack of explicit policies regarding technology usage in schools is a problem that

extends beyond individual schools, affecting districts and provinces as well. Munje and Jita (2020) further imply that the policies of districts regarding the strategies employed by schools to address the challenges associated with technology utilisation in educational settings appear to lack clarity. Furthermore, there is a notable absence of a comprehensive plan to guarantee the sustained integration of technology in schools for pedagogical objectives. Therefore, it appears that the challenges faced by schools in integrating technology can be attributed to the lack of a comprehensive technology foundation plan at the district level.

Ojo and Adu (2018) draw the conclusion that certain schools in South Africa have formulated their own policies, while others are lacking explicit guidelines regarding the future implementation of these policies and on the training of the school's teachers in their use of technology in their teaching. Similarly, the findings from the research conducted by Dube et al. (2018) documented the dissatisfaction expressed by certain teachers in specific primary schools in South Africa regarding the rules and entrenched customs imposed by school leaders, particularly principals. These rules pertain to the hierarchical allocation of technology usage privileges among teachers and limitations set for the subjects for which these digital tools can be employed in the classroom. According to Pacheco, Barry, Cronkleton and Larson (2008), rules may be classified as either formal or informal, and informal rules may be grounded in a school's customs. Also, in an earlier study, Winiecki (2001: 148) explained that a broader range of informal institutions, also known as informal rules, include traditions, tradition-based customs, religious and ideological views, as well as self-imposed codes-of-conduct. Smith and Becker (2021) expand on this phenomenon by noting that, even when informal norms are committed to paper, they often lack authoritative versions in the form of codified texts and authoritative sources of interpretation such as those used in courts. An informal rule's interpretation (and often even its very existence) is therefore constantly contested within the community that it governs (Smith & Becker, 2021). One could posit that certain rules or customs enforced by school leaders, supposedly aimed at incentivising teachers, actually impede and discourage their utilisation of technology within the context of education.

Shiburi (2021) asserts that the establishment of school-based ICT policy should be entrusted to a committee specifically dedicated to ICT matters inside the school. This idea aligns with the conclusions drawn from a study conducted by Razzak (2015). The argument posits that the effective implementation of digital teaching by educators necessitates the establishment of support

structures that enable educators to raise their ICT proficiency levels and confidence. According to Shiburi (2021), based on the findings of his research conducted in some schools throughout Gauteng province, a recommendation was that the committee develop an ICT policy to provide guidance for the incorporation of ICT tools in the classroom for curriculum implementation. Furthermore, it was seen as essential for this committee to focus on the allocation and administration of ICT resources, as well as on the development of educators and the ICT implementation methods involved in their teaching.

Vanderlinde et al. (2011) emphasised the importance of establishing the roles and responsibilities of school-based ICT committee members and considering their expertise in empowering and assisting educators in their successful implementation of digital teaching. This observation is particularly relevant given government's substantial investment in technological resources in education. The school-based ICT committee should comprise of different stakeholders, such as teachers, parents, and IT professionals, each of whom is entrusted with certain specific obligations (Vanderlinde et al., 2011). These responsibilities include a range of tasks, including, but not limited to, website support, technical assistance, network maintenance, and Information Technology (IT) fundraising. Although this section mentions the ICT committee as a potential empowering factor for educators, there is a need for in-depth exploration of the roles and responsibilities of such a committees. This current study focuses on understanding the structure, functioning, and impact of ICT committees in schools, examining how these committees specifically support primary school in-service teachers in the successful implementation of digital teaching within the context of hybrid CoPs.

Additionally, Shiburi (2021), based on his findings, recommends that the principal serve as the accounting officer, and the heads of departments, who play a crucial role in driving the curriculum, be included as members of these committees. The result of this could be that school-based leaders may potentially have a significant influence on the creation and sustaining of an environment that fosters the growth and enhancement of much needed ICT skills. According to Knipp (2019), one potential strategy for principals to employ to enhance teachers' expertise and self-confidence is the creation of avenues for teachers to observe their colleagues who can serve as exemplar models. Additionally, principals can facilitate co-teaching professional development and practice, offer constructive feedback, and foster the growth of CoPs. This section indicates that school principals'

rules and customs regarding technology use may directly influence teachers' learning within their CoPs. A research gap exists in understanding the specific ways in which principals impact the participation of teachers in hybrid CoPs. This could involve education researchers investigating the extent to which principals encourage or hinder teachers' involvement in collaborative learning initiatives.

2.5.2. Insufficient institutional support

Hart (2023) asserts that there exists a subset of principals who do not place a high emphasis on the integration of technology within educational settings. This lack of prioritisation may stem from personal attitudes or opinions regarding the matter or may be influenced by external factors beyond their jurisdiction, such as the pressing need to address fundamental educational infrastructure requirements. According to Hart (2023), leaders who are motivated and possess a visionary mindset can potentially mitigate those challenges faced by learners which are due to limited technology access and lack of technological experience. This mitigation can be achieved through offering encouragement and support to teachers who are attempting to become technologically competent, and to overcome any resistance. Ojo and Adu (2018) proposed that the comprehensive implementation of an ICT policy in all schools is necessary to facilitate the widespread utilisation of technology by teachers. Maceviciute and Wilson (2018) assert that the aim of ICT policies, particularly in schools situated within socio-economically disadvantaged areas, is to encourage the adoption of technology by educators and learners belonging to these marginalised socio-economic groups. The objective of these policies would not only be to reduce the disparity in digital access, but also to facilitate unrestricted engagement of individuals in social and economic activities after leaving school and/or in the world of work. According to the findings of Munje and Jita (2020), the current conditions observed in certain schools in South Africa suggest that the Department of Basic Education (DoBE) should reassess its strategies and regulations regarding the integration of technology for pedagogical purposes in schools. Specifically, there is a need for the DoBE to improve its methods of identifying and addressing the unique challenges encountered by individual schools throughout the nation.

2.5.3. Historical disparities

According to Dlamini and Mbatha (2018), the insufficient integration of technology may also be attributed to historical inequities, including apartheid policies that resulted in disparities in resources and governmental support within some regions. These inequities include issues such as the presence of underqualified educators and inadequate allocation of resources in some regions. Additionally, contemporary classrooms and learners confront several obstacles in the 21st century (Dlamini & Mbatha, 2018). The examination of the governance and financial aspects of South African schools post-apartheid may be linked to the period (early 1990s) immediately before the end of apartheid, during which the National Party government established Model B and C schools (Sayed, Motala, Carel & Ahmed, 2020). According to Model A, the school would undergo a complete transition to a private institution. In contrast, Model B proposed that the school would retain its status as a state school. Lastly, a Model C school would become state-aided or semi-private, with its management council assuming responsibility for various aspects such as school operations, staff appointments, fee determination, and facility maintenance. Schools categorised as Model C would be eligible for a state subsidy to fund the wages of staff members who are recruited in accordance with predetermined state guidelines. These schools were required to maintain a racial composition that could be mostly white and could prioritise the admission of white learners from their respective feeder districts. Currently, the former model C schools are widely acknowledged to possess superior resources in comparison to formerly disadvantaged schools due to the historical benefits they were afforded, resulting in a disproportionate allocation of resources and teachers between schools in affluent and impoverished regions of South Africa. This phenomenon is apparent in research performed by Lumadi (2020) who asserts that the discrepancy in the socio-economic status of citizens of South Africa has compelled the government to implement a financing strategy for public schools. The programme is predicated around allocating funds to schools that are deemed economically disadvantaged due to their location in impoverished neighbourhoods. Many of these educational institutions exhibit deficiencies in terms of infrastructure, as well as limited access to both physical and financial resources, all of which hinders their effective operation and academic performance. In contrast to these schools, the previous Model C schools have sufficient resources to support their optimal functioning (Lumadi, 2020).

2.5.4. Resistance to change by teachers

Mathipa and Mukhari (2014) have posited that the insufficient utilisation of technology for pedagogical objectives cannot solely be attributed to institutional or external constraints, as previously discussed. It can be attributed also to barriers at the teacher level, such as a lack of confidence, resistance to change, and many teachers' negative attitude towards technology. The above argument was subsequently substantiated by Dube et al. (2018) in a separate investigation. They asserted that, despite the availability of sufficient technological hardware for primary school teachers in South Africa, the adoption and utilisation of technology in pedagogy in the Gauteng province were hindered by negative attitudes and low levels of teachers' computer self-efficacy. According to Dlamini (2022), in schools where teachers identify themselves as being born prior to the advent of technology, the function of confidence in the integration of technology tends to become significant, particularly due to its notable association with attitude.

In order for teachers to cultivate a sense of confidence in using technology in their profession, it is imperative that they be provided with enough access to opportunities for professional development. The research conducted by Dlamini (2022) indicates that individuals with low levels of confidence tend to have a propensity for developing negative attitudes towards technology tools. According to Mathipa and Mukhari (2014), there are teachers who hold fast to the belief that technology does not provide any advantages either for themselves or for their learners, an attitude which manifests as resistance towards using technology for teaching and learning in their classrooms. Other factors that have been investigated in relation to teachers' use of technology for pedagogical purposes include age, as found by Mahlo and Waghid (2022) and Umugiraneza et al. (2018). The research conducted by Umugiraneza et al. (2018) aimed to examine the factors contributing to the older participant teachers' hesitancy in adopting ICTs in contrast to their younger counterparts who had just completed their university education. A subset of the more senior educators in the research cohort had, throughout the course of their education, not been afforded opportunities to receive formal instruction in the use of technology. Their research results indicate that female and younger teachers possess a relatively elevated degree of computer literacy compared to their male and older counterparts. In alignment with the findings of Umugiraneza et al. (2018), the Teaching and Learning International Survey (TALIS, 2018) revealed that younger teachers have a higher propensity for using technology compared to their older counterparts, as do

teachers who have had in-service training which included training in ICT. According to Peralta and Costata (2007), teachers who possess greater levels of knowledge, confidence, and a positive attitude towards their skills in using technology are more likely to incorporate them effectively into their teaching practice. Hence, the presence of external impediments, as previously stated in this chapter, may contribute to the development of negative attitudes and reluctance among teachers towards the use of existing technologies. However, while Dlamini (2022) highlights the significance of confidence in technology integration, he does not delve into the specific contextual factors influencing teachers' confidence levels. Research could explore these contextual aspects, which could include school culture, available resources, and support systems that either enhance or hinder teachers' confidence in utilizing technology and actively participating in CoPs.

Undoubtedly, technology holds a crucial position in educational environments, and its absence can adversely impact the learning process and the academic achievements of learners. Several studies have emphasised the significance of technology in the context of teaching and learning. For instance, as mentioned in the previous section Kolobe and Mihai (2021), and Munje and Jita (2020), have conducted recent research that supports this notion. Kolobe and Mihai (2021) found that successful integration of technology in the classroom to assist advanced learners leads to favourable outcomes. Similarly, Munje and Jita (2020) discovered that technology has the potential to decrease failure rates, thereby reducing the number of learners who require additional support to meet promotional criteria. Based on my personal observations, it is evident that there exists a need for teachers to receive training in a practical and interactive manner which reveals for them the advantages associated with the integration of technology within educational settings. In the course of this kind of practical training teachers may gain an appreciation of the significance and value of incorporating technology into their teaching routines, while at the same time acquiring important hands-on experience. According to Li et al. (2018), teachers are more inclined to incorporate technology into their teaching practices when they possess a comprehensive understanding of the advantages associated with their use. According to Farjon, Smits, and Voogt (2019), positive experiences are likely to contribute to teachers developing favourable perspectives of, and attitudes towards, the integration of technology into their pedagogical practices.

2.6. Defining Communities of Practice (CoPs)

Groups of people that have the same interest, whether they meet in person or online, form CoPs (Lave & Wenger, 1991; Wenger, 1998; Wenger, McDermott & Snyder, 2002). CoPs are groups that "share a concern, a set of difficulties, or a passion in a subject and who enhance their knowledge and experience in this field by interacting on a regular basis" (Wenger et al., 2002: 4). The learning that takes place in CoPs "occurs within the framework of social connections with other members of the community who have comparable, if not identical, difficulties and concerns from the world of practice" (Buysse, Sparkman & Wesley, 2003: 267). The purpose of a CoP is to promote the advancement of collective knowledge, which in turn encourages the development of expert knowledge (Hung & Nichani, 2002). CoPs aim to create an environment where everyone's opinions are respected, and the group is able to reconcile different points of view (Hung & Nichani, 2002). It is a group of people who have worked together on a project or have other ties to the same field for an extended period and have developed a shared understanding of the issues involved (Barab, Makinster & Scheckler, 2004; Lave & Wenger, 1991). These definitions imply that learning can—and often does—occur because of social interactions in a CoP rather than having to be intentional. Mercieca (2016) argues that CoPs are volunteer groups of people who get together because they have a common interest or concern to investigate certain issues, share ideas, and develop their practices. Consequently, the definition of a CoP diverges from alternative community definitions in numerous aspects, notably in its emphasis on belonging or membership, which hinges on a feeling of connection to a specific community rather than on formal, structured, and tangible membership categories (Wenger, 1998). Learning happens in the same setting as it is put into practice, and thus it makes sense that members of CoPs meet together to talk about new concepts, share their experiences and their knowledge, and provide one other with support.

To describe the organic process through which outsiders join, learn from, and eventually contribute to, an existing CoP, the earlier work of Lave and Wenger (1991) suggested a socio-cultural theory of learning. Community members who have been in the community the longest are considered core participants; newcomers who are legitimately part of the community but are still learning the ropes are considered peripheral participants (Cuddapah & Clayton, 2011:63). After gaining experience on the periphery of a CoP, newcomers are better prepared to go into the centre, where they may contribute their entire range of expertise (Cuddapah & Clayton, 2011; Lave & Wenger,

1991). Through tangential engagement in genuine activities with established members, newcomers get access to the community's professional knowledge tools and social standards (Schlager & Fusco, 2003: 4). After some time, a newcomer will move from the community's outer circles, where he or she is still considered a novice, to its inner core, where he or she is considered an expert in his or her field (Lave & Wenger, 1991). However, Lave and Wenger (1991) barely scratched the surface of the importance of identity and CoP in understanding genuine marginal involvement.

The primary shortcoming of Lave and Wenger's (1991) definition of CoP is that it ignores the possibility of learning across communities that are entirely made up of newcomers with respect to a given knowledge. In other words, Lave and Wenger (1991) indicated that learning cannot occur in a new group that exclusively consists of "newcomers," an assertion with which I disagree. The connection between socio-cultural transformation difficulties and the shifting relationships between newcomers and longtime members in the context of a shifting shared practice is particularly important, according to Lave and Wenger (1991: 49). The CoP social learning theory, extensively discussed in Chapter 3, was later presented by Wenger (1998) to fill this gap. In a subsequent study, Wenger (1998) intentionally shifted the emphasis away from the individual and their immediate social context. Instead, he examined broader factors such as common cultural frameworks, socio-political structures, and particularly, the dynamic relationship between practice and identity within pre-existing or newly formed communities. Wenger (1998) argued that social practices are the product of a type of community formed over time by the prolonged pursuit of a joint enterprise, mutual involvement, and shared repertory. These practices are used in the pursuit of enterprises and the social ties that go along with them. Thus, it is appropriate to refer to these communities as CoPs.

Companies, organisational structures, governments, schools, trade groups, nonprofits, and even international aid efforts and community service have all adopted the CoP model (Wenger, 2011). The next section, using concrete examples, focuses only on how CoPs affect the professional growth of teachers and other professionals within the workplace context.

2.7. CoPs within school workplace contexts

Business professionals have been quick to embrace CoPs as they understand that knowledge is a strategic asset that must be handled effectively (Wenger, 2011). A company or organisation of any size nowadays would be hard pressed not to have some kind of CoP programme (Wenger, 2011). Wenger (2011) stresses the fact that public institutions, just like private ones, confront increasingly sophisticated and extensive knowledge difficulties. Even though the formality of bureaucracy might get in the way of open knowledge sharing, government organisations have chosen CoPs for the same reason as have firms in the private sector. As much as in any other kind of organisation, so there are increasing knowledge difficulties and deficiencies for educational institutions. The spaces where CoPs have first been put to use are in teacher education institutions, and in spaces needing to connect geographically separated administrative leaders with their peers (Wenger, 2011). There is a surge of interest in these peer-to-peer professional development initiatives. For the sake of this study, three (*n=3*) sampled primary schools together serve as an example of a CoP in education space, one which is a setting where groups of teachers with similar interests and working methods share their knowledge, cooperate in projects and form social bonds.

There is an increasing amount of literature that has considered the establishment of CoPs whose purpose is to assist educators in engaging in shared learning, and to reflect on their teaching practice (Baya'a et al., 2019; Bouchamma, April & Basque, 2018; Brooks, 2010; Byington, 2011; Chigona, 2013; Cotter et al., 2017; Coutinho & Lisbôa, 2013; Cuddapah & Clayton, 2011; Davis, 2015; Jho et al., 2016; Kopcha, 2012; Macia & Garcia, 2016; Mahlo & Waghid, 2022; Mustikawati & Tarwiyah, 2022; Papay, Taylor, Tyler & Laski, 2020; Schlager & Fusco, 2003; Thang et al., 2011; Yang, O'Reilly & Houghton, 2020; Xu & Ko, 2019; Yildirim, 2008). A CoP is seen by this large number of education researchers to be an effective event that teachers themselves may create, and whose purpose is to increase the effectiveness of professional development. Educators found that a CoP provides them with fruitful opportunities to discuss their actions, problems and concerns with others in a group (Mustikawati & Tarwiyah, 2022). According to Mustikawati and Tarwiyah (2022), a CoP is a capability to support teachers' transformational practices and creativity. These practices and capabilities include identity development, relationship-building, and the creation of social structures. Jho et al. (2016) published their findings on the elements that contributed to the success of an effort that brought together teachers in Korea, while Chigona (2013) investigated the

ways in which pre-service teachers in South Africa were able to use technology to establish CoPs. Mutual respect, collaborative effort, and shared repertoire are all innovative approaches that have led to the establishment of CoPs. These have been found to emerge when teachers communicate with one another and work together toward the achievement of a common goal (Jho et al., 2016; Chigona, 2013). The findings of the research done by Xu and Ko (2019) suggested that teachers from three sampled primary schools in Hong Kong engaged in mutual engagement when they discussed lessons after the conclusion of three open lessons and during various cluster meetings (such as lesson planning meetings and final evaluation meetings). When preparing for the responsible open lesson, teachers from the same school participated in the conversation about problems around lesson design and instruction (Xu & Ko, 2019). The discussion of a lesson plan subject and the creation of a practical lesson were examples of joint enterprise in the case cluster.

Baya'a et al. (2019) conducted research in Israel, which involved surveying third-year student teachers and experienced in-service teachers with a minimum of five years of teaching experience at the lower secondary school level. The study aimed to explore how a CoP could facilitate in-service teachers in acquiring the necessary knowledge for effective technology integration in their classrooms. Various methods were employed to encourage in-service teachers to incorporate technology into their teaching practices (Baya'a et al., 2019: 129).:

- Watching and reflecting on video clips of in-service teachers from the previous year using technology in the classroom.
- Together with pre-service teachers, collaboratively developing classroom lessons that make use of digital resources.
- Observing the present pre-service teachers while they were conducting technology-based Mathematics lessons.
- Teaching together with the pre-service teachers.
- During bi-weekly meetings with in-service teachers, student teachers, and lecturers of student teachers, reflecting and strategizing on issues surrounding the incorporation of

> technology in the Mathematics classroom as a whole and on various themes relating to teaching practice (Baya'a et al., 2019: 134).

Results from the Baya'a et al. (2019) study show, however, that newcomers are not always on the outside of a society; sometimes they are immediately integrated into its innermost circles. In addition, the findings of Baya'a et al. (2019) constitute a valuable example of developing a shared repertoire of resources and developing mutual engagement. Mahlo and Waghid's (2022) research conducted in the Western Cape demonstrates a similar phenomenon. They found the inexperienced teachers in their case study to possess the skills and expertise to integrate technology successfully into their lessons despite their lack of formal training. Thus, one can entertain the possibility that, even though new educators often have less classroom experience, their possession of technology knowledge and skills is often the case. Cuddapah and Clayton (2011) argue that in-service teachers of varied levels of teaching experience benefit from having access to both in-person and online CoPs. Chigona (2013) gathered together pre-service teachers for a creative endeavour: creating interactive digital narratives about their preparation for, and entry into, the teaching profession. These future educators collaborated in the exchanging of information (which included personal stories, classroom challenges, and teaching strategies. The sharing and collaboration between these teachers resulted in the enhancement of the knowledge of each one of them. Furthermore, participants negotiated their identities and meanings through the creation and sharing of digital stories. In a similar vein, a Korean study by Jho et al. (2016) examined the impact of a TPD programme across two schools and found that the schools shared similar dimensions or attributes which included open mindedness and self-innovation as a joint enterprise, a reciprocal relationship, continuous role exchange as mutual engagement, educational materials, and abundant time as a shared repertoire. The findings of Jho et al. (2016) add to the idea that it can occasionally be preferable and advantageous to bring in teachers from various schools. In this context, teachers are able to network with other educators, for instance, by means of in-service teaching programmes or local teacher gatherings.

Studies referenced in this section illustrate the significance of context as a prospective study topic. However, the studies stop short of identifying a suitable theoretical framework for how teachers' knowledge growth might take context into account. The CoP social learning theory is not completely addressed in the research studies cited in this section since they focus only on the three

CoP dimensions, while ignoring the four other components of community, practice, meaning, and identity. On the assumption that the ideas of community, practice, meaning, and identity provide a theoretical lens for studying learning as social interaction, more thorough research would be deemed to incorporate all the elements of CoP (Wenger, 1998). In addition, it is reasonable to assume that studies, such as those of Baya'a et al. (2019), Chigona (2013), Jho et al. (2016) and Xu and Ko (2019) focused on formal CoPs rather than focusing on informal CoPs: the CoPs in their studies were intentionally and specifically formed for data collection and/or because, in the Jho et al. (2016) study in particular, teachers were included in data collection on the basis of their having previously participated in a certain TPD. This implies that some teachers from the schools in these cited studies were excluded from the data collection. Due to this omission, the findings of such research can be said to be incomplete, since teachers who did not participate in the TPD programme are not represented in the data. The current research is based on the assumption that it is important to note that teachers tend to construct CoPs naturally, one of the reasons being that they find this to be the only way they can acquire the knowledge and skills – and support – that they need. This notion resonates with Wenger (1998), who explained that CoPs are everywhere, and, because they are informal and pervasive, they are rarely focused on in research. Cotter et al. (2017) drew the conclusion from their study that casual group interactions, such as a regular coffee hour for the institution may help towards the creation of CoPs. Staff members might meet one another and talk about their duties, problems, and potential for cooperation in a casual, non-pressurised social setting during informal group meetings. These have the potential to play a significant role in enabling a CoP to evolve organically inside the school (Cotter et al., 2017).

These ideas corroborate the findings of Lohman's (2005) research. The following personality qualities or features were discovered to enhance teachers' willingness to participate in informal learning: proactiveness, self-confidence, passion for learning, curiosity in the subject, dedication to professional growth, a caring disposition, and an extroverted nature. In other words, teachers who take part in a CoP have access to lifelong, and to ongoing informal professional development (Mahlo & Waghid, 2022). What little cooperation there is, according to Cotter et al. (2017), often takes place informally, seldom, and without any premeditation. For instance, Tiba (2018) found that teachers who were already comfortable with technology were willing to hold workshops for their peers out of the goodness of their hearts, and this led to improved relationships between these teachers. Thus, it is important to examine the various approaches to the formation of CoPs. In

addition, the literature seems to suggest that organisations need to explicitly promote CoPs, and in certain circumstances even allow them grow naturally (Cotter et al., 2017).

Even though there have been more than 20 years of study on CoPs by 1998 (Wenger, 1998), to date few organisations have identifiable CoPs in place whose collaborative aim is to ensure the professional development of their human resources, and even when they do have what they call CoPs, these seldom mature (Bouchamma et al., 2018). More than 25 years ago Winch (1998) saw the difficulty with workplace learning to be that there are several, unique situations of learning, each one subject to constraints in a variety of contexts and cultures, therefore it should not always be seen as the ideal remedy for poorly functioning of ineffective TPDs. This assertion is similar to that made later by Lohman (2005), who argued that teachers' participation in informal learning activities is typically hampered by a lack of time, distance from colleagues' workspaces, and financial constraints. A lack of organisational support, a lack of desire on the part of others to participate in informal learning activities, and subject matter experts' accessibility were discovered to be three additional factors that tend to prevent teachers from participating in informal learning (Lohman, 2005). The suggestion made by Lohman (2005) was that these factors could be causes of teachers' decisions to work alone. Cotter et al. (2017) provides more confirmation that teachers tend to work in isolation, with individuality and competition, rather than collaboration and sharing, serving as the norm. A lack of teacher involvement and cooperation would work against the emergence of CoPs. Contrary to some arguments, public primary schools in South Africa and other locations, as suggested by Mahlo and Waghid (2022) and Hargreaves (2021), do not function independently. It is possible that number of schools in the same region may form a CoP whose purpose would be to encourage and motivate teachers in these schools by facilitating the exchange of materials, expertise, and ideas for addressing challenges at other schools which are members of such a CoP, including challenges which are a result of lack of technology adoption. These studies demonstrate the crucial importance of researchers being prepared to balance their analysis of knowledge obtained independently with knowledge developed via engagement in the workplace. In addition, researchers need to consider the macro and micro contexts in which their studies are done.

Bouchamma et al. (2018) found that when educators worked together, this improved learners' academic performance. In this context, research conducted by Baya'a et al. (2019) and by Phillips

(2017) has shown that teachers who participate in CoPs are more likely to use the knowledge and skills they acquire in these than those who work independently. According to the findings of Baya'a et al. (2019), pre-service teachers were a key source of TPACK for in-service teachers. For instance, after collaborating with pre-service teachers, in-service teachers reported that teaching independently after the mentorship inspired them to establish new objectives and develop new strategies for integrating technology in their Mathematics teaching (Baya'a et al., 2019). Mentoring, as defined by Alam (2019), can be any interaction between a more experienced and less experienced individual, and is an interaction that aims to promote the latter's personal and professional development. Mentoring a new teacher involves a complex process of providing guidance, advice, and morale boosting (Alam, 2019). With this approach, experienced educators act as guides to those who are new to the profession or have fewer years of experience. New teachers often work in pairs with more seasoned educators, who act as mentors through the school's policies and procedures, provide assistance with pedagogical and academic challenges, and encourage each other's professional and personal development (Alam, 2019). New teachers have been found to benefit more from informal mentorship than from formal mentoring in a CoP, as pointed out by Du and Wang (2017). Alam (2019) concurs with the findings of Du and Wang (2017) that informal mentoring plays a crucial role in fostering professional growth and success. However, Alam (2019) emphasise that formal mentoring is not intended to replace informal mentoring, but rather to complement and enhance it within the context of teachers' CoPs. Research on the impact of CoPs on the growth of in-service teachers' TPACK as a result of informal mentoring in the context of their professional practice has in general not gone into significant detail (Baya'a et al., 2019; Mahlo & Waghid, 2022). Instead of the researcher actively participating in the formation of CoPs for the sake of data collection, in the present study my aim was to understand the specific ways in which the informal hybrid CoPs in the study were developed, with a focus on those which already exist in schools based on the reviewed literature and my own experience. The CoP framework developed by Wenger (1998) is used in this study as a primary framework to assess the TPACK growth of the participating in-service teachers in their respective school settings.

In order to effectively integrate technology into teaching and learning, it has been widely recognised that teachers must enhance their TPACK (Koehler & Mishra, 2009). Phillips (2017) echoed this sentiment. TPACK, as described by Cox and Graham (2009), may help educators better understand the potential advantages of new technologies in the classroom. According to

Phillips (2014), there are elements and restrictions that affect the impact of CoPs on the TPACK development of in-service teachers: (1) Processes of identity formation and practice are elements of the context in which a person enacts TPACK; (2) There are many different categories of people that may be considered members of a CoP, not only newcomers and core members but also near-peers and liminal members; (3) Through mutual participation, TPACK may be seen as knowledge in the process of being created. In light of these elements and restrictions listed by Phillips (2017), it is vital to highlight that the present research also focuses on validating and/or contrasting these significant findings by Phillips (2014); this is something that needs to be mentioned. TPACK development within CoPs has been the focus of Phillip's (2017) research. Sadik (2021) conducted a research study at a university located in the Midwest region of the US. The findings of the study revealed a significant relationship between pedagogy, content, and technology, and highlighted their importance in the preparation of pre-service teachers enrolled in technology integration courses, as well as in all teacher education courses. In a university setting in China, Guo (2022) conducted a study which examined the structural features of TPACK and the impact of CoPs on English teachers at university level. The findings of his research provide confirmation that the CoP is a valuable resource for the enhancement of TPACK among university English teachers. Additionally, the collaborative nature and reciprocal exchange of ideas within the CoP significantly contribute to the teachers' learning and professional growth. From a study conducted by Wang (2020) at a primary school in California, US, it was found that the CoP on which the study focused played a crucial role in facilitating the growth of the participant teachers' TPACK by providing them with community-type support.

The above cited studies have significance for the current study and for education research in general, as they represent a yet limited body of research that examines the processes behind learning and, more specifically, how teachers acquire the ability to develop TPACK within the context of their professional environment. The objectives, aims, and problem-solving approach of the current research are similar to those cited in the aforementioned studies. While acknowledging the significance of previous studies (Guo, 2022; Phillip, 2017; Sadik, 2021; Wang, 2020), it is important to note that my intention is not to undermine their value or raise scepticism over their findings. The CoPs that examined in previous research were established in a structured and formal manner, in contrast to the informal CoPs explored in the present study. The teachers who participated in my study were unaware of their inclusion in any formal or mandated way in these

CoPs. In contrast to the present research, the studies reviewed used single case study approaches with limited participant numbers, typically ranging from one to seven teachers per study, and inside specific and often structured working situations. In my opinion, a more thorough and meaningful investigation would look at a sizable, carefully chosen sample of several schools with the goal of establishing the truthfulness of the CoP hypothesis. It is important to acknowledge that the present study is based on three cases of schools situated in a historically disadvantaged township in the Western Cape. Therefore, caution should be exercised when attempting to generalise the findings to a global context, as well as to South African schools in more affluent urban areas. However, it is reasonable to extend the generalisability of the study's findings to schools located in similar areas within South Africa. This is supported by previous research which has demonstrated that many schools located in socio-economically marginalised regions in South Africa encounter comparable challenges related to insufficient skills and knowledge (Chigona, 2018; Dlamini & Mbatha, 2018; Graham et al., 2020; Hardman & Tshink, 2019; Koranteng & Chigona, 2016; Lembani et al., 2020; Mahlo & Waghid, 2022; 2023).

Many of the previous studies reviewed (Guo, 2022; Phillip, 2017; Sadik, 2021; Wang, 2020) were carried out at educational institutions located outside of Africa and in economically affluent settings, in contrast to the three schools included in the present study, which are situated in a historically and socio-economically marginalised region of South Africa. This suggests that the environment in which the participant educators functioned has a distinctive organisational structure that differs from the norm seen in several other public schools in South Africa. In addition, in the study conducted by Phillips (2017), it was observed that the educational institution under study represented the only specialised select entry school in the province/state, and focused on Mathematics, Science, and Technology. Furthermore, according to Phillips (2017), the learners enrolled in the school exhibited exceptional academic abilities and consistently achieved high levels of success. Unlike learners in other educational settings, particularly those in the current study's selected schools in South Africa classified as "previously disadvantaged," in Phillips' (2017) study the learners did not pose the same problems in terms of classroom management. Thus, the extent to which the findings of Phillip (2017), Guo (2022), Sadik (2021), and Wang (2020) may be applied to a broader population is restricted. The studies examined in this review fail to adequately recognise the significance of ties between teachers in fostering the establishment of CoPs that may effectively impact and enhance teachers' TPACK development

within the working environment. These studies examined the potential existence of themes and processes within a theoretical framework that could help in explaining the development of in-service teachers' TPACK. While this current study did not aim to validate CoP as a theory, the aforementioned studies simply investigated whether, from this theoretical vantage point, the themes and processes that could be uncovered to help explain how in-service teachers acquire or have acquired TPACK. Furthermore, these studies failed to conduct comprehensive examinations of the problem, as they overlooked the role that online technological tools play in supplementing and strengthening CoPs, particularly in the 21st century. To clarify, these studies only used in-person CoPs as their primary source of data, without using a combination of online and in-person CoPs. The significance and value of these studies lies in their contribution to research, particularly in their examination of the influence of CoPs on teachers' TPACK development. However, from my perspective, a more comprehensive investigation would include both online and offline CoPs, an investigation which focuses specifically on asynchronous hybrid approaches across a variety of schools. The present study, which I see as constituting a significant contribution to the field, is the first research within my knowledge that investigates the influence of hybrid CoPs on the development of teachers' TPACK. By conducting an analysis of CoPs that integrated both online and in-person methods for sharing knowledge (referred to as hybrid CoPs), the objective of my study was to address the existing gaps in the current body of literature.

2.8. Hybrid CoPs within school workplace contexts

CoPs may be created either entirely online or in a hybrid format, as highlighted by Byington (2011: 288). While in an online-only CoP all communication and collaboration occurs over the internet, a hybrid CoP incorporates both virtual and in-person interactions. A hybrid place is one in which "the conflicting knowledge of discourses of diverse spaces are brought into "conversation" to question and re-shape" (Moje, Ciechanowski, Kramer, Ellis, Carrillo & Collazo, 2004: 43). By bridging the gap between online and physical communication and storage, the hybrid community has the potential to provide a long-term solution to the digital divide and add to the ongoing discussion on the value of virtual communities in social settings (Gaved & Mulholland, 2005). It is possible that people's experiences in hybrid spaces may evolve into places where they can share their ideas and opinions on important problems, as well as express their creativity and introspection (Busher et al., 2014). More essential than the simple provision of a network infrastructure is the

idea of cultivating a community that uses both offline and online means to facilitate social interactions (Gaved & Mulholland, 2005). Twitter, Facebook, and many other internet-based community sites provide communities where individuals can connect and share in real time, bridging the gap between the immediate and the distant (Zhao, 2006). In addition to in-person and phone interactions, they facilitate the development of hybrid social groups among individuals (Busher & James, 2015). Busher and James (2015) further add that there is a rise in the prevalence of hybrid communities which use online and offline modes of connection to develop their activities. A comparison of face-to-face and online CoPs is provided by (Byington, 2011: 288):

Face-to-face CoPs	Online CoPs
Membership is restricted to a certain geographic region.	Membership is not restricted based on location, which enables a wide range of representation.
Requires a location for meeting. Face-to-face meetings may incur significant costs in terms of both time and physical resources.	Requires access to internet. They incur no extra costs, making efficient use of time and resources.
Meetings are scheduled at specified days and times that may not be convenient for everyone.	Members have the ability to log into the online community at any time and choose suitable periods to engage.
Members participate in activities that need face-to-face contact but have a time constraint, such as conversations or small-group projects.	Members participate in an interactive online environment, such as online courses, blogs, and wikis, without any restrictions on the amount of time they may spend.
Typically, online materials are not shared or easily available. There is no existing record of contact.	Online materials are distributed and readily available. A repository of communications is accessible.
The majority of the time, technological advancements are not used.	Various technological improvements, such as slideshows, video clips, and graphics, may be used.

Table 2.1: Comparison of face-to-face and Online CoPs

Table 2.1 suggests that technological advancements may alleviate the difficulties of traditional CoPs by creating a more accessible and dynamic setting for meetings. This in turn suggests that the development of online and/or hybrid CoPs can be greatly aided by technological advancements. As a result of technological advancements, educators now have more freedom to network with one another across time and geography (Byington, 2011). Caudle (2013) conducted

a study in which she described how she established teaching and social presences within a 3-month duration of a CoP consisting of four pre-service teachers and four mentor teachers. She concluded that the opportunities for critical discourse and the development of co-inquiry among the participant teachers were made possible by the face-to-face meetings. Caudle (2013) also argues that, even if face-to-face meetings were essential to the development of a community, the continual communication and the introspection made possible through internet are equally important. People employ online, visual, and textual media interactively with face-to-face interactions to build and maintain friendships, romantic partnerships, and professional networks (Busher & James, 2015; Littlejohn & Pegler, 2006). Thus, individuals engage in a variety of activities on a daily basis, both online and offline, to foster relationships and communities.

Therefore, it is evident that people constantly reinterpret and test their identities and connections with other people through their face-to-face and online conversations. A continual, dynamic and complicated interaction between the real and virtual worlds is used to jointly create and interpret internet users' daily lives in order to give meaning to their lives in specific temporal and spatial contexts. Leander and McKim (2003: 219) support the idea that some individuals "make meaning of their experiences across online and offline spaces, producing identities without an exaggerated separation between these spaces". Hybrid spaces can develop into places for creative self-expression, introspection, or for expressing worries and opinions about problems affecting people's life (Busher et al., 2014). For instance, when examining the viewpoints of in-service teachers on the use of Twitter as a tool for TPD in the US, Davis (2015) suggested that online meetings allow teachers to reflect on their own practices, share their knowledge and experience, and communicate with peers. Schlager and Fusco (2003) assert that online technologies like Twitter may have both positive and negative consequences on the creation, growth, and maintenance of social media inside CoPs. To give just one illustration, many educators identify the chances for professional development and the feeling of community that these online CoPs offer when asked what they appreciate most about them (Davis, 2015). On the other hand, even though hybrid and/or online meetings have advantages, they also have drawbacks. For instance, Thang et al. (2011) suggest that online CoPs are mostly reliant on written communication and lack nonverbal paralinguistic cues. Put simply, due to the reader's inability to clearly detect the communicator's genuine feelings and emotions, as s/he would in a face-to-face interaction, it is not always possible to prevent misinterpretation. Members of the online CoP may also have concerns over the indefinite

preservation and accessibility of their thoughts or opinions to the public (Thang et al., 2011). While these studies acknowledge the importance of technology in creating and sustaining CoPs, they do not provide a complete understanding of the specific ways in which teachers' TPACK can be cultivated via these online CoPs.

For a number of reasons, as argued by (Thang et al., 2011), members of online CoPs may be hesitant to have their ideas and viewpoints documented and made publicly accessible indefinitely. In addition, according to Pape, Reinecke, Rohde and Strauss (2003), the challenges of establishing authentication systems for identity, trust, and reputation present a major obstacle to online communities. In online communities, it is common practice to obscure or otherwise distort one's identity (Pape, Reinecke, Rohde & Strauss, 2003). Problems with trust and identity plague purely online groups, which frequently try to mimic traditional, in-person gatherings in physical locations (Gaved & Mulholland, 2005: 1). Bringing people online as part of their local community is one possible answer to these problems; the addition of a network infrastructure and online tools could be beneficial for both individuals and the community as a whole (Gaved & Mulholland, 2005). Using the trust mechanisms inherent in in-person social groupings, these hybrid communities may be able to overcome the challenges of solely digital ones, while the in-person community may reap the benefits of a network architecture and of digital technologies. However, Busher and James (2015) argue that demographic characteristics such as age, gender, social position, and cognitive expertise, are likely to be significant determinants of engagement in hybrid communities. The fundamental idea behind social media, in my opinion, is the ability to share material with people in all contexts and contingencies, including during impossibly difficult situations such as pandemics, while I acknowledge the drawbacks associated with its use.

Successful online workshops, according to Treacy, Kleiman, and Peterson (2002), require knowing when and how to do in-person gatherings. These authors argue that it is essential to understand that, while one or more well organised face-to-face encounters may considerably enrich the online learning experience, this is not always practical, and many online workshops operate effectively when delivered solely online (Treacy et al., 2002). According to Gaved and Mulholland (2005: 1), it is generally agreed that online communication may be utilised to supplement and expand the social interactions, storage, and transmission of information that occur in the physical learning environment of a course or workshop. This claim is supported by the claims of Busher and James

(2015), in their study of hybrid communities using both online and face-to-face communications. They supported their claim with an example of learners, arguing that learners learn informally in a variety of settings, including online and offline, alone and in groups, and with individuals of various ages. While hybrid spaces may still be more of a pipe dream in the setting of schools, they do have the potential to improve teacher training (Lynch, 2015). Thus, based on these studies, and on my experience, making connections, through a variety of means, between novice and experienced educators may help classroom practitioners meet the demands, such as integrating new technologies, of curriculum delivery in the 21st century.

Busher et al. (2014), Busher and James (2015), Byington (2011), Caudle (2013), Gaved and Mulholland (2005), Lynch (2015), and Macia and Garcia (2016) are among the few researchers who have looked at hybrid CoPs. These studies do not, however, investigate or assess how hybrid CoPs affect educators' professional growth nor their acquisition of TPACK. For instance, while Busher et al. (2014) explored the efficacy of hybrid CoPs, their study included college students only, not teachers, as in the case of the current study. Busher and James (2015) delved into the concept and meaning of hybrid communities and the potential of these communities for teachers to do research on their practices via hybrid techniques in order to better understand the lived experiences of their fellow members. Macia and Garcia's (2016) study is further limited in that it only reviews prior research on informal online communities and networks as a source of TPD, ignoring in-person meetings, and discussion of TPACK was absent. The synchronous research by Sumandiyar et al. (2021) examined the efficacy of hybrid learning as a teaching tool in the context of the COVID-19 pandemic. As already mentioned, Caudle (2013) described how he established teaching and social presences within a three-month hybrid CoP comprising of four pre-service teachers and four mentor teachers. Since the hybrid CoP was staged or organised, there is a significant flaw in Caudle's (2013) study, one that suggests the author may have had direct control over the data gathering procedure and conclusions. For instance, the mentors were requested to contribute to the blog at least once each week. This researcher's activity makes it quite evident that mentor teachers could have felt compelled to comment on the public blogs even though they may not have had anything to say. In light of this, I contend that this hybrid CoP did not occur naturally, as did the hybrid CoPs in the case of the present study. It must be noted that each of the three ($n=3$) sampled schools in this current study had a hybrid CoP. However, even when teachers from different schools come together, the schools themselves can function as hybrid CoPs. Highly

notable is the fact that the influence of CoPs on the growth of educators' TPACK has also not been sufficiently addressed in previous studies. It is also clear, from all that has been reviewed and discussed in detail so far, that technology is crucial to teacher communication inside the various forms and functionings of CoP discussed so far.

2.9. Online technological tools used to support CoPs

There has been a notable surge in the use of social networking sites and Web 2.0 in educational settings in recent years. The increase has led to the development of new opportunities for the establishment and exploration of online or virtual CoPs (Peeters & Pretorius, 2020). CoPs and their efficacy may be developed and improved by a variety of technological tools, including, but not limited to, email (Bouhnik & Deshen, 2014; Byington, 2011), wikis, discussion boards, chats, podcasts, and blogs (Byington, 2011). Other technologies for use in online CoPs include Facebook chat, Twitter (Bouhnik & Deshen, 2014), YouTube (Osterrieder, 2013), WhatsApp (Bouhnik & Deshen, 2014), Remind App, Dropbox, and learning management systems such as Google Hangout, Google Classroom, Google Voice, Google Forms, Google Meet (Singh & Awasthi, 2020), SeeSaw, Schoollogy, and video conferencing (Zoom) (Singh & Awasthi, 2020). Additional communication technological tools designed specifically for educational purposes include Blackboard Collaborate, Gather, Google, Codecademy, Moodle, Pluralsight, Skillshare, Coursera, Teachable, and others (Böhmer, Schwab & Isso, 2024: 58). I would add that these tools, and the knowledge and skills for using them, have the potential to make learning online more efficient and straightforward. Educators may benefit from online meetings because of the increased opportunities they provide for introspection and interpersonal connection (Byington, 2011). Only four (*n=4*) online communication tools are discussed in more detail in this current study.

2.9.1. Facebook group feature

Mai, Nguyen, Tran, and Le (2020) conducted a study in which they analysed the textual content of posts and comments inside two distinct Facebook groups for a duration of five (*n=5*) months. The research focused on the engagement of 84 educators in Vietnam and included information regarding their perceived benefits from and recommendations for their membership in the CoP. Bett and Makewa (2018) performed a study in low-income countries where options for teacher TPD were limited. These researchers focused on analysing the content of posts inside a Facebook

group. It has been discovered that this platform has evolved as a helpful medium for schoolteachers in Kenya to exchange and participate in conversations related to their English and literature topic expertise. In the study conducted by Lantz-Andersson et al. (2017) the researchers examined the utilisation of Facebook groups by Swedish teachers who formed these groups for the purpose of discussing their respective subjects, instructional approaches, methodologies, and assessment strategies. The findings of this Swedish study indicated that, when existing patterns of behaviour and accepted standards were questioned, the critical dialogues which emerged appeared to foster collaborative learning and encourage contemplation on instructional and learning practices, which could potentially influence classroom dynamics. Therefore, an essential attribute of this kind of self-organised social media group for teachers is its capacity to facilitate opportunities for a shared and collaborative exchange of practical and theoretical pedagogical concepts, fostering collegial learning and stimulating contemplation on teaching methodologies (Lantz-Andersson et al., 2017). From the findings of the studies of Bet and Makewa (2018), Lantz-Andersson et al. (2017), and Mai et al. (2020), it can be deduced that the integration of comment threads and posting functionalities inside Facebook group chats facilitated the operational effectiveness of CoPs. Thus, these features can enable the participation of individuals in prolonged interactions, including the interchange of ideas and materials. It is important to highlight that conversations may be initiated in reaction to the content given by a member of a group, including different types of content, such as written text, photographs, videos, or audio recordings. Following on from this, more individuals inside the collective may participate in the act of providing comments and responses to a specific post.

2.9.2. WhatsApp

WhatsApp is a widely used social networking programme that facilitates communication and interaction among individuals, to date used mostly for the purpose of engaging in conversations with friends and family members (Asmara, 2020). Lua (2023) claims that, as of March 2023, WhatsApp emerged as the third most extensively used social media platform, with a user base of 2 billion individuals. Facebook claimed the top position with a staggering 2.96 billion members. WhatsApp is defined by Asmara (2020), and by Bouhnik and Deshen (2014) as a software programme for smartphones that lets users send and receive instant messages, both one-on-one and in large groups. Bouhnik and Deshen (2014) further add that WhatsApp has been available to

the public since 2010, and its original intent was to replace the preexisting Short Message Service (SMS) network with a cost- and advertisement-free alternative. The programme has several features, including a function enabling users to send text messages, pictures, audio files, video files, and Uniform Resource Locators (URLs) (Asmara, 2020: 21). In a study conducted by Moodley (2019), the author examined the use of the WhatsApp platform as a virtual CoP to supplement in person meetings of teachers and officials in a rural area located in the North West province of South Africa. Following their participation in a professional development course, this platform was used to track their progress and provide ongoing assistance.

Moodley's (2019) results indicated that the successful use of WhatsApp as a means of facilitating a virtual CoP is dependent upon the participants' understanding of the contextual factors that shape the community's existence, as well as on their openness to embracing other perspectives and viewpoints. A study conducted by Ajani (2021) in the KwaZulu-Natal province of South Africa found that the content of WhatsApp groups plays a significant role in facilitating teachers' professional development in the context of e-learning. Teachers actively engage in online CoPs with the intention of accessing professional development opportunities and obtaining knowledge that can enhance their instructional delivery in the classroom. In a study conducted by Bouhnik and Deshen (2014), the authors examined the use of WhatsApp in educational settings in Israel, specifically focusing on its use in communication between teachers and learners. The findings of their research revealed that both teachers and learners highlighted many technical advantages of WhatsApp, including its user-friendly interface, affordability, widespread accessibility, and real-time communication capabilities. Based on the research referenced in this section, it can be inferred that the primary functionality of WhatsApp lies in its group chat and messaging capabilities. These features can enable members of a CoP to engage in the sharing of diverse forms of media as well as discussions of common problems. Thus, this platform supported the speedy flow of information among members of the CoP under study. The research suggests that WhatsApp's perceived ease of use is a significant motivating factor for teachers when compared to other social media platforms. Furthermore, the phone and video call features offered by WhatsApp provide more convenient and comprehensive discussions in comparison to other social networking sites.

The literature in this section indicates the potential for social media groups to facilitate platforms for teacher professionals' discussions. These foster collaborative problem-solving, resource sharing, and the exchange of teaching experiences and examples. The utilisation of social media for TPD can be conceptualised as an expanded virtual space akin to a staff room, where educators convene to engage in teacher-led professional discourse pertaining to pedagogical matters, as well as to address practical instructional challenges. The characterisation of online discussions as an extended staff room can also be examined with a focus on the underexplored aspect that these discussions frequently occur and extend beyond teachers' designated work hours. Even though education researchers such as Ajani (2021) and Moodley (2019) acknowledge WhatsApp's many advantages, also point out the app's drawbacks. These include the incessant barrage of unnecessary messages and the impression many people have that the service is not a legitimate or serious means of contact. I agree with this finding of Bouhnik and Deshen (2014), one which was confirmed by Kim, Leary, and Asbury (2021) in their research. Moreover, Macia and Garcia (2016) argue, from their research, that, in social media communities, a considerable proportion of individuals opt to remain passive, or 'free loaders', benefiting from the contributions made by others. However, in many cases, a minority of educators actively participate by sharing their experiences and resources and offering reciprocal support. Macia and Garcia (2016) have noted that a considerable proportion of teachers have a tendency for assuming a passive stance inside educational environments. These educators gain advantages from getting to participate in discussions launched by others and using shared teaching materials, but seldom contribute their own perspectives or share ideas. Kim et al. (2021) also discovered that several educators in their study came to see the benefits of social media networking with colleagues as outweighing the drawbacks. These drawbacks took the form of the distraction of regular alerts and the demoralising nature of certain posts. All of this illustrates how technology is double edged: although it may have the power to unite people, it also has the capacity to blur the borders between work and personal life, which might negatively affect both their physical and mental health.

2.9.3. Electronic mail (email)

Peterson, Hohensee, and Xia (2011) assert that electronic mail (email) is a widely used technological tool for contemporary communication, and one that differs from social media platforms. The quantity of email correspondence sent by workers in all spheres has seen a

significant increase over the last twenty years, as reported by The Radicati Group (2021). Pollock and Hauseman (2019) assert that, with the advent of the Internet, e-mail has had a significant and transformative influence on the operational landscapes of several professional sectors, including education. For example, the study conducted by Pollock and Hauseman (2019) revealed that the utilisation of emails by principals in certain Canadian schools offered several benefits. These benefits encompass the provision of convenient and efficient communication with and between stakeholders, the opportunity to enhance workload management, and the ability to establish a documented record of daily communications, thereby ensuring accountability. In addition, the adoption of email has been motivated by its potential to facilitate immediate interaction, enabling individuals to transmit messages to recipients instantaneously and without significant delay. Moreover, in Chron's (2020) study, it was found that email recipients were afforded the flexibility to access and review their communications at their convenience. The advent of email communication has revolutionised interpersonal connections by enabling more concise and frequent exchanges compared to those done using traditional letters and a postal service, resulting in significantly reduced response times (Chron, 2020). This suggests that the use of emails not only functions as an efficient means of communication, but also as a dependable mechanism for nurturing professional connections with colleagues, especially in the context of establishing online and/hybrid CoPs among colleagues.

Pollock and Hauseman (2019) highlight the challenges related to the use of emails arguing that the use of emails also presents several problematic issues, such as the regularity of an excessive amount of email correspondence, the extension of work hours, an increase of work responsibilities, heightened expectations for quick responses, and the erosion of the separation between professional and personal domains. The results of a comprehensive review conducted by Stich, Tarafdar, and Cooper (2018) suggest that employees encounter technological stress issues associated with workplace communication when using electronic communication tools such as e-mails. These challenges manifest in the form of technology overload, interruptions, and work-home interferences. The aforementioned research provides evidence that workers may be experiencing feelings of being overwhelmed and stressed due to the high volume of emails they receive. Additionally, the research suggests that employees see email as a source of role overload, regardless of the amount of time they spend managing their email correspondence (Lanctot & Duxbury, 2022). Thus, organisations need to find an appropriate balance between providing

workers with desired technology and safeguarding them from risks associated with such technology. It is important to acknowledge an apparent dearth of research which investigates the utilisation of e-mails inside the professional setting, encompassing both work-related communication and personal exchanges among colleagues. There also exists a scarcity of empirical research which provides greater certainty pertaining to the use of email communication within the professional domain of educational institutions among educators. Hence, the present study aimed to address this research gap by including the examination of the importance and value of email use in facilitating the functioning of existing teachers' hybrid CoPs in schools.

2.9.4. Video conferencing

Video conferencing has emerged as an alternative to email and social media, and/or, in some cases, as an additional tool for sharing professional information. Some of the few accessible video conferencing alternatives are Google Meet, Zoom, and Microsoft Teams (Singh & Awasthi, 2020: 1). For many industries, including business, education, healthcare, and more, video conferencing has become a must-have tool (Gladović, Deretić & Drašković, 2020: 47). Using this online tool, participants in a video conference may see and hear each other in real time (Al-Samarraie, 2019). Simply put, video conferencing is a method of communicating visually and aurally between persons who are physically separated by time and space but are connected through the internet. Hopper (2014) argues that distance learning classes, professional development sessions, discussions with teachers, "virtual" field visits to museums to supplement lessons, and inter-school collaboration are just some of the ways in which video conferencing has been used within the realm of education. Video conferencing, for instance, is a means of delivering distance education that allows for more efficient and cost-effective delivery of learning and training than an email exchange would, as emphasised by Gladović et al. (2020), who studied the technology's use in Serbia's higher education institutions. Over 200 million people use Zoom every day, making it the most popular video conferencing app, as reported by Singh and Awasthi (2020).

According to Singh and Awasthi (2020), despite competition, Zoom’s user-friendliness has kept it at the forefront of the video-conferencing market. Okabe-Miyamoto et al. (2021) validated this finding while studying the effect of video conferencing among employees across various professions in the US during the COVID-19 pandemic. Of the participants, 51% used Zoom, 30% used Skype, and 10% used Google Hangout. Microsoft Teams, on the other hand, is employed for

educational reasons by education institutions, such as numerous schools, in over 175 countries (Singh & Awasthi, 2020). For instance, Glessner and Johnson's (2020) research on the perspectives of special education teachers in the field during the COVID-19 pandemic revealed that teachers used "virtual meetings," as they are frequently called, to coordinate efforts to address the needs of learners with disabilities. Okabe-Miyamoto et al. (2021) also discovered that the daily rate of Zoom users increased from 10 million to 200 million users per day during the COVID-19 pandemic, in a period of just four months. The use of video conferencing for teaching has been the subject of numerous studies (Hopper, 2014; Gladović et al., 2020; Ramos Salazar, Garcia, Huntington & Brooks, 2022; Samala, Marta, Anori & Indarta, 2022), but researchers have found less evidence of its effectiveness for teacher-to-teacher communication. Thus, this current study hopes to close this research gap. The research referenced here does not provide a thorough and detailed explanation of the specific ways in which teachers' professional knowledge is created in and by these online CoPs beyond reiterating the premise that technology plays a crucial role in creating and sustaining CoPs. Since these studies do not explore nor account for the possibility that some teachers may have a fear of computers, which would mean that they lack the ability and confidence to utilise technology effectively in their teaching, and thus these teachers may prove to be of limited value in providing a solution to forming and employing CoPs for sharing practices and for contributing to the development of teachers' professional knowledge. Some people may find it difficult to contribute meaningfully to online communities because of the absence of personal connection. This current research employed hybrid CoPs as a means of bridging these gaps. Moreover, based on the research discussed in this chapter it is reasonable to argue that, even though COVID-19 was something of a disaster for humankind, it also served as a wake-up call for everyone, especially teachers, to recognise the importance of ICTs in a number of areas. In this regard, the COVID-19 pandemic may have had a significant and positive effect on the world's educational system.

2.10. The impact of COVID-19 on global education systems

Unknown viral pneumonia caused a widespread panic in Wuhan, China, in December 2019. The discovery of a new coronavirus, SARS-Cov2, was reported by the World Health Organisation (WHO) on January 9, 2020 (Marinoni, Van't Land & Jensen, 2020). This new virus is the causative agent of COVID-19 (Coronavirus Disease), an infectious respiratory illness (Marinoni et al.,

2020). By 11 March 2020, the WHO classified COVID-19 a global pandemic due to its rapid global spread (Landa, Zhou & Marongwe, 2021; Marinoni et al., 2020). More than 3.4 billion people, or 43% of the global population, were under lockdown in more than 80 countries and regions by 1 April 2020. The president of South Africa proclaimed a national state of disaster on March 26, 2020, under the Disaster Management Act of 2002. On the same day, schools throughout the country were placed under lockdown, as per the standards for education in emergencies (Landa et al., 2021). Immediate and far-reaching consequences for education were felt, not only in South Africa but across the globe as a result of the lockdown and social distance policies.

In response to the COVID-19 outbreak schools in 137 countries were closed, affecting 1.5 billion learners (Kim & Asbury, 2020). educational institutions developed plans to help learners catch up on missed schoolwork and return to classes without having lost ground once schools reopened. The global face-to-face education system was damaged by the COVID-19 pandemic (Tadesse & Muluye, 2020). As a result of this widespread phenomenon, several nations have improved their infrastructure for broadcast education, online education, and virtual classes. "Virtual classrooms had become the norm for both learning and teaching" (Hargreaves, 2021: 1838). Böhmer et al. (2024) describe this time as a 'new normal age' due to the significant influence of the COVID-19 crisis on the worldwide educational sector. Böhmer et al. (2024) explain that adapting to the new normal required a range of new strategies, such as online delivery, collaborative ideas, digital learning futures, distance education, and simulation in teacher education. Some countries planned to employ educational technology, free online learning materials, and educational broadcasts to teach learners (Tadesse & Muluye, 2020). Governments saw distance learning as continuing on a permanent basis, and as providing learners with a high-quality education. Learners having ready access to technology and to the internet was crucial to the success of distance education. I tend to disagree with the foundational ideas of Hargreaves (2021) regarding the normalising of virtual classrooms. I argue that, while virtual education may be the norm in developed nations, it may not be the case in most underdeveloped and developing nations, such as South Africa, where resources are scarce. Hardman's (2021) research is in line with my viewpoint, with her emphasis on the fact that, despite the abundance of research supporting the benefits of incorporating technology into conventional lessons, the education system was confronted in 2020 with the impossibility of face-to-face engagement due to the COVID-19 school closures. Further, Hardman (2021) argues that this was particularly difficult in a developing country like South

Africa, where 70% of the population has poor or no internet connection/connectivity, making it impossible to employ software such as Zoom, which allows for face-to-face contact. Landa et al. (2021) add that the COVID-19 pandemic response has revealed a widening socio-economic gap among educational institutions. It is of concern to Di Pietro, Biagi, Da Costa, Karpinski and Mazza (2020), as well as to Landa et al. (2021), that learners from wealthier families were less likely to experience the negative effects of COVID-19 than were learners from poorer families because the former attend schools with more advanced and plentiful technological resources and very likely have teachers with more advanced technological knowledge and experience.

Although research on the effects of COVID-19 on learners worldwide is important, one significant drawback of these studies (Hargreaves, 2021; Kim & Asbury, 2020; Landa et al., 2021; Tadesse & Muluye, 2020) is that they only concentrate on learners, while omitting the effects on teachers. Relatively little attention has been paid to how distance or 'remote' learning affects teachers. Given that teachers' wellbeing is the single most important factor affecting the ability of learners to learn, this research gap would seem to be of vital importance. COVID-19 affected educators and learners equally. Online teaching and learning separated educators from the everyday interactions and meetings that make up the school day (Hargreaves, 2021). According to Trust and Whalen (2020), educators faced a variety of challenges when tasked with emergency remote teaching, including a lack of experience with online/remote teaching approaches and tools. In fact, Kim and Asbury (2020: 1063) note that the transition to distance education may have impacted teachers' sense of professional identity since it interrupted and altered the nature of social ties between colleagues. Fifty years ago, Granovetter (1973) categorised these ties in two distinct categories: strong ties and weak ties. Close relationships are referred to by him as strong ties, while distant connections are referred to as weak ties. Both kinds of ties play a crucial role in the exchange of information. However, as stated by Erickson (2004) and Lin (2001), weak ties allow individuals to reach out to a greater number of persons and resources outside their community. Further elaboration on the concept and implications associated with strong and weak ties may be found in in Section 2.10 of this chapter, and in Chapter 3, Section 3.3 of this study.

Hargreaves (2021) claims that, if one looks at the inadequate support afforded teachers by educational institutions during the COVID-19 pandemic, one sees educators turning to one another for assistance. Kim and Asbury (2020) and Kim, Leary, and Asbury (2021) agree that at this time teachers began to appreciate their professional ties with their colleagues, with many finding that these professional relationships blossomed into true friendships that were a valuable source of support. Similarly, Lu, Liu, Yuan, Lu and Li (2022), in their study, discovered that individuals were more inclined to disseminate information among their strong-tie networks than among their weak-tie networks. Teachers in Ireland held Zoom and Google Meets the week the government announced a COVID-19 lockout so that they could communicate with one another, evaluate new rules for the transition to online classrooms, and discuss their experiences of teaching and learning in virtual environments (Yang et al., 2020: 3). Colleagues discussed the benefits and drawbacks of each strategy they could employ to keep learners interested, and how to deal with the difficulties of helping learners in different time zones (Yang et al., 2020). The group settled on a strategy that would make use of existing digital resources, while keeping in mind that both teachers and learners were at the beginning of a very steep learning curve. Hargreaves (2021), Kim and Asbury (2020), Kim et al. (2021), and Yang et al. (2020) all draw on this fact to conclude that teachers may have had particularly close social bonds with one another throughout the COVID-19 pandemic owing to available technologies for instant communication. It must be noted that interaction between teachers during the COVID-19 pandemic did not only take place between teachers at the same school but with teachers from different schools as well. In his study, Alwafi (2021) concluded that teachers seemed to have developed weak ties while they were interacting with other professionals via Twitter during COVID-19 pandemic. Alwafi's (2021) findings somehow contradict those of Carmody, Mazzarello, Santi, Harris, Lehmann, Abbiasov, Dunbarvan and Ratti (2022) who contend that employees who are not co-located are less likely to form ties, weakening the spread of information in their workplaces. The findings of Carmody et al. (2022) suggest that teachers belonging to two different CoPs are less likely to form ties.

One Scottish school district's executive director commented on the positive relationships the district's educators had been able to cultivate with the many stakeholders in their system as a result of the pandemic's impact on their work (Hargreaves, 2021: 1849). Kim et al. (2021) discovered that classroom teachers at this time largely believed that the support they needed was inside their school, and particularly from their colleagues, and that some teachers cited online professional and

social activities as highlights of their careers. The finding by Kim et al. (2021) offers the possibility that the practice of teachers seeking information and emotional support from colleagues could have been driven by natural instincts among teachers which emerge during a crisis. To this end, Glessner and Johnson (2020) highlight the fact that teachers in the field of special education reported that they valued interpersonal communication with their peers more than ever before while implementing distance learning strategies, and that this led to the development of strong relationships among these and other educators during the pandemic. These educators in the study reported that the COVID-19 pandemic prompted a rise in cooperation among themselves, with online meeting spaces playing a particularly important role. Teachers are more likely to sustain their commitment to teaching if they feel valued by each other and by their leaders as trusted colleagues (Sahlberg & Walker, 2021).

It is possible to conclude that technology used in the service of teacher communication had a critical part to play in preserving teacher relationships during the COVID-19 outbreak since certain educators were found by researchers to be able to interact with one another. It is unclear, however, if this was the case in undeveloped and developing countries with inadequate resources. As a result, the generalisability of much published research on this topic is questionable. Because of the isolation of teachers from one another during the COVID-19 pandemic, there may have been a lack of unity in impoverished and developing countries. Glessner and Johnson (2020) express agreement with this supposition, writing that when cooperation was absent due to COVID-19, and greater demands were imposed on teachers, a distinct sense of disconnection was evident. As I previously stated, colleagues frequently resorted to their coworkers for emotional support when under strain (Kim & Asbury, 2020), and this was not possible for some teachers during the pandemic in developing countries. Thus, the fact that teachers' professional values and stress management practices may occasionally coincide, highlights the importance of teachers' close relationships with one another. I agree with Hargreaves (2021) that strong social links and emotional support from colleagues are essential for teachers to be able to accomplish their work successfully, and that teachers benefit from the spontaneous and free flow of thoughts and knowledge possible in collaborative professional development networks.

Teachers' support networks at school and in the profession may prove highly valuable as they adapt to the new realities ushered in by COVID-19 (Kim & Asbury, 2020). A key finding from the research conducted by Jakubowski and Sitko-Dominik (2021) was the importance of establishing and maintaining healthy social relationships between teachers during COVID-19 pandemic and beyond. While there has been extensive research on the impact of COVID-19 on global education, there remains a gap in understanding the effects of the pandemic on teachers' relationships in relation to their TPACK development. Unstructured professional development, such as mentorship or online forums, was advocated for by Trust and Whalen (2020) as a means of training for already-employed educators. The goal is to provide them with experience in teaching in a variety of online, distance, and hybrid contexts, where they may put their newly acquired technological knowledge to use. In this respect, the findings included above also emphasise the necessity to examine teachers' interactions with one another in hybrid CoPs during the COVID-19 period, specifically with relation to teachers' support for one another's TPACK growth. Even though there has been a significant body of research generated on the mental states and relationships of teachers during the COVID-19 pandemic (Bintliff, 2020; Hargreaves, 2021; Yang et al., 2020), there is no evidence of a single study which has investigated, and which explains the strength of teachers' ties during the COVID-19 pandemic while sharing information with one another. This present study aimed to fill such a gap by exploring how the strength of ties influenced the transfer and development of teachers' TPACK, specifically during the COVID-19 pandemic. This research could provide opportunities for better-informed guidance in the event of future pandemics or other national or global crises. Assessing the correlation between stronger and weaker ties, and their influence on knowledge transfer, might provide useful insights into the dynamics of social interactions and their effects on teachers' learning outcomes in the context of TPACK growth during times of crisis. Chapter 5 will go into further detail on this topic.

2.11. Chapter summary

The adoption of technologies involves intricate interdependencies that may at times be contradictory and evolve over time. These interdependencies exist among technological, pedagogical, and content requirements, and are influenced by the social contexts that shape teachers' practices (Mishra & Koehler, 2006). In this chapter, a comprehensive literature analysis has been conducted on the influence that CoPs (especially in-person and virtual CoPs) have on the

growth of teachers' TPACK. A more thorough examination of the phenomena necessitated further subdivision of the topic into several headings. Following on after this, a literature review was conducted on the history that led to the present situation of TPD programmes throughout the globe, as well as in South Africa and the Western Cape. According to published research, the TPD programmes offered by governments, in particular those in the WCG, are insufficient for a variety of reasons. One of these reasons is that these programmes do not supply participating educators with the requisite knowledge essential for teaching which makes use of technology. A review of literature concerning the essential knowledge required for technology-integrated teaching highlighted TPACK as a crucial component for effective curriculum delivery in technologically equipped environments. Further investigation into how teachers make use of TPACK revealed that diverse teachers can employ the same technology in innovative and varied manners, provided it is applied appropriately, resulting in benefits for both teachers and learners. This was one of the findings that emerged from the literature review. A literature analysis of TPD projects that have been initiated by the WCG was also conducted, and four important TPD projects in the Western Cape were investigated. An additional literature review was conducted on the background history of the definition of CoPs and their role in education. According to this literature review, it is evident that a growing body of research has examined the establishment of CoPs whose purpose is to assist educators in engaging in shared learning and in reflecting on their teaching practice. When it comes to the cultivation of teachers' professional knowledge within CoPs, however, there seems to be a scarcity of studies. The literature that was reviewed on this topic also emphasised how important it is for organisations to establish CoPs both online and in person. The literature suggests the urgent necessity for educational institutions to make use of social media technologies to enhance the face-to-face CoPs that are currently present in many schools (workplace). Further research suggested that hybrid spaces may be more of a pipe dream in the context of schools; yet there is inarguably the potential for them to contribute to the professional development of teachers. On the other hand, there is no evidence that research has been carried out on the specific topic of hybrid communities within the setting of schools and with reference to teachers' TPACK professional development. According to research conducted to date, not only are hybrid CoPs possible, but they also have the potential to be the most efficient method of developing new, and enhancing existing teachers' knowledge, in particular the knowledge that is considered indispensable for teaching in those classrooms equipped with technological resources. A literature review on research conducted on

the relationships between teachers was done, and the findings of that research review show that, during COVID-19, educators' connections with one another were robust in comparison to those that existed before COVID-19. Even though the literature does not go into detail regarding the relationships between teachers during the COVID-19 outbreak, my judgment and, of course, the implications of earlier research, suggest that the relationships between teachers during the pandemic were stronger than they had been in the past. In general, the research that was looked at suggested that hybrid CoPs might have a significant impact on the growth of teachers' TPACK and play an essential role in doing so, particularly in a crisis such as COVID-19. TPACK is often portrayed as an independently acquired, aspirational position in the research literature. This is a viewpoint that contrasts with the socially mediated employment setting in which most teachers find themselves and their practices (Phillips, 2014). In the next chapter the conceptual framework that was used in this research is broken down and discussed in detail.

CHAPTER 3: THEORETICAL FRAMEWORKS

3.1. Introduction

The main aim of this research was to examine how and to what extent a sample of in-service primary school teachers' development of TPACK was influenced by their participation in hybrid CoPs. To establish the theoretical foundation for this research this study was guided and organised by three theoretical frameworks, namely the CoP social theory proposed by Wenger (1998), the Strong and Weak Tie Theory as outlined by Granovetter (1973; 1977) and the TPACK framework developed by Mishra and Koehler (2006). The soundness of the conceptual framework utilised in this study was guaranteed through the combination of these theoretical frameworks.

According to Phillips (2014), educators and scholars frequently encounter inadequacies in TPD programmes offered by governments. As a result, in-service teachers often resort to informal CoPs to acquire the requisite knowledge for successfully incorporating technology into their teaching methods. The current study examines the CoP social learning theory as a framework for understanding the approaches, motivating factors, and limitations involved in the establishment of CoPs (Wenger, 1998) by educators, the aim of which is participants' acquisition of TPACK. The adoption of social Strong and Weak Ties Theory as a theoretical framework was deemed necessary, as it highlights the significance of individuals' ties inside and outside of their CoPs. This theory, as proposed by Granovetter (1973), elucidates the potential strength and weakness of these ties. Furthermore, I utilised the TPACK model to identify the essential knowledge (Mishra & Koehler, 2006) that educators acquire within these non-formal CoPs. The present chapter has been divided into the following sections:

- Section 3.2. The nature of CoP social learning theory and how it is used
- Section 3.3. The nature of Strong and Weak Tie Theory and how it is used
- Section 3.4. The nature and use of the TPACK model
- Section 3.5. Explores the nature and use of CoP social theory of learning as a natural context in which teachers' social ties develop while learning TPACK from one another
- Section 3.6 Chapter Summary

The following sections provide an in-depth explanation of each theoretical framework and shed light on the connections between these frameworks.

3.2. The nature of CoP social learning theory (Wenger, 1998)

In their book titled, "*Situated learning: Legitimate peripheral participation. Learning in doing*", Lave and Wenger (1991) developed a socio-cultural theory of learning to describe how context influences human social activities while people involved in these activities are developing their practices, meanings, and identities. Lave and Wenger (1991) explain the concept of legitimate peripheral participation which describes how outsiders gradually join, learn from, and contribute to an existing CoP. Existing community members are complete participants, while legitimate peripheral participants are individuals who are apprenticing inside the group (Lave & Wenger, 1991). During the stage of peripheral involvement, newcomers transform their identities into full engagement (Wenger, 1998). Thus, a newcomer who is viewed as a valid potential full member of a community learns how to think, act, speak, and be as a full member (Cuddapah & Clayton, 2011). Lave and Wenger's (1991) work did not adequately investigate the concept of CoP, despite its importance in understanding appropriate peripheral participation. In developing the CoP social learning theory, Wenger (1998) placed further emphasis on the notion in his book *Communities of Practice: Learning, Meaning, and Identity*. In other words, it can be assumed that Wenger's (1998) concept of a CoP originated from Lave and Wenger's (1991) work on legitimate peripheral participation. Wenger (1998) argued that CoP social learning theory can be regarded as a theory as it provides a theoretical framework from which to derive general principles for understanding and facilitating learning.

Wenger (1998) conceptualised a CoP as a network of social connections and shared understandings formed around a particular work process through the active engagement of its participants. It comprises individuals involved in a shared profession or activity (Lave & Wenger, 1991), or an informal association or interest group within an institution, established with the explicit purpose of fostering collective learning and nurtured through managerial initiatives (Wenger et al., 2002). This structure, with its dynamically interrelated components/characteristics, is illustrated in Table 3.1. Barton and Tusting (2005) assert that the concept of a CoP is predicated on the assumption that individuals often congregate in groups to carry out activities in their everyday lives, in the workplace, and in educational settings. Hence, as per Wenger (1998; 2011), CoPs are groups of

individuals who regularly interact due to a shared interest or passion in a particular activity or field, from which they enhance their skills and knowledge through collaborative engagement. In the same vein, Jho et al. (2016) conclude that the CoP space is a learning environment that nurtures the growth and refinement of practice. Within a CoP, members participate in the negotiation of meaning and enterprise, while at the same time actively participating in different types of interaction to enhance their roles as members. Wenger (2011: 1) later elaborated on his original definition, arguing that, while this definition allows for intentionality, does not imply it: the pursuit of learning can serve as the common motive that brings the community together, or it can be an unintentional result of members' interactions with one another. The fundamental consistency between these several definitions is that the primary unit of analysis in a CoP theory of learning is not the individual learner, nor the social institutions, but rather the CoPs themselves. According to the CoP social learning theory originally developed by Wenger (1998), the practice-based social interactions shape what individuals become. Within the context of Wenger's (1998) CoP social learning theory, the term "community" refers to a group that is formed via mutual engagement, joint enterprise, and a shared repertoire. Thus, a CoP may be characterised by these three dimensions. Wenger (1998) provides a concise summary of the interaction that exists between the characteristics of mutual engagement, joint enterprise, and shared repertoire in a CoP. This interaction is illustrated in Figure 3.1 below:

3.2.1 Dimensions of a CoP

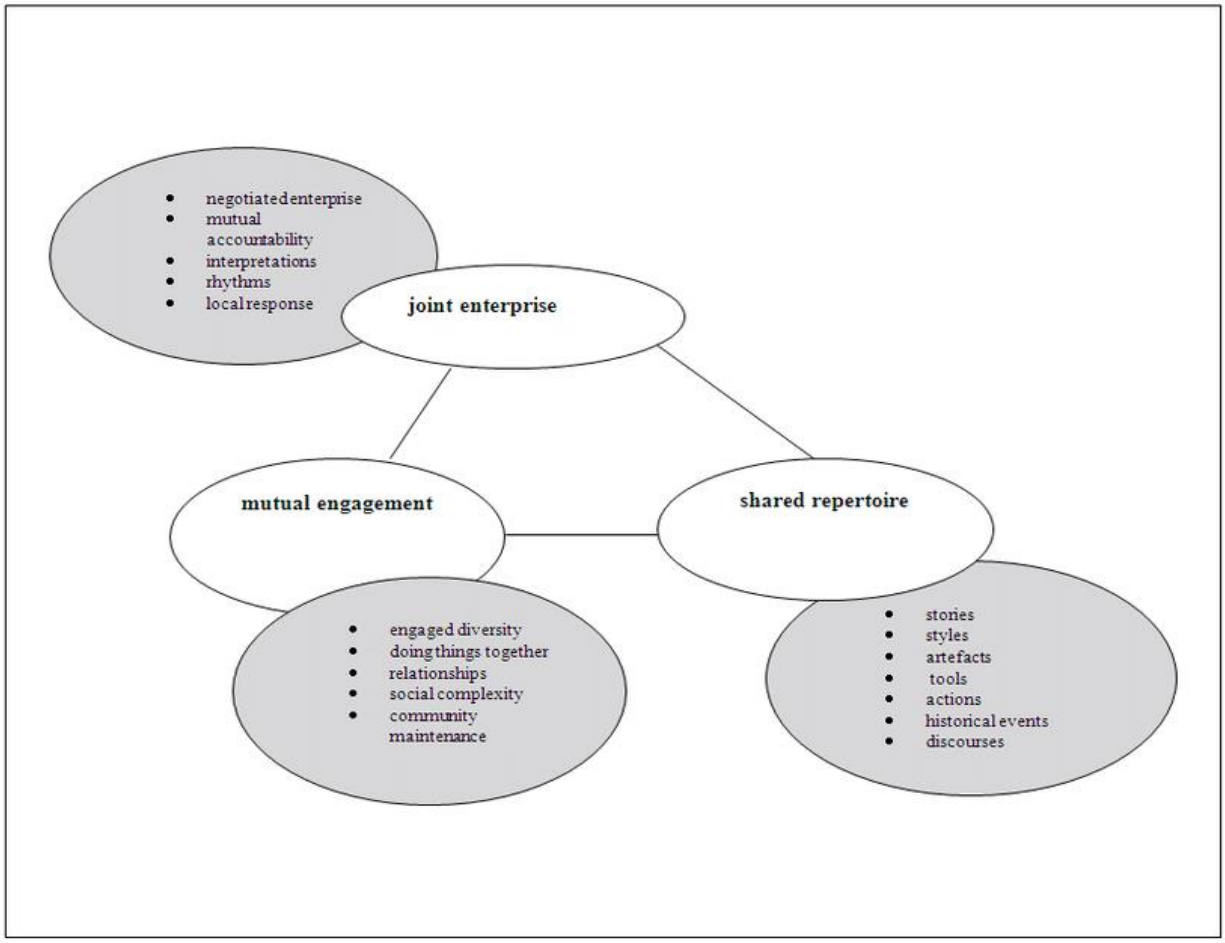

Figure 3. 1: Dimensions of a CoP as the property of a community (Wenger, 1998: 73)

3.2.1.1. Mutual engagement

Within any community, one of the most essential sources of coherence is that of mutual engagement (Besamusca, 2013; Miguel, Clare, Ashworth & Hoang, 2022; Wenger, 1998). In a study carried out by Jho et al. (2016), the term "mutual engagement" was defined as the ongoing interaction that takes place between members of a community, in addition to the roles and ties that come about as a direct result of this interaction. Wenger (1998) noted that members of a CoP undertake mutual engagement with one another and developed a practice through the process of working together, checking, and disputing the meaning of what they were doing together. According to more recent research by Miguel et al. (2022), as represented in Table 3.1, CoP members must participate in mutual engagement, which includes interpersonal connection,

relationship formation, mutual support, and participation in joint activities. Members who participate in this manner feel that their efforts are valued by the community (Wenger, 1998). For example, the study conducted by Akinyemi et al. (2019) explored the impact on the improvement of TPD in high schools located in Western Cape of collaboration and mutual support as established processes within CoPs. Their findings revealed the participant teachers to have actively engaged in collaborative learning activities within their CoPs, in the process, fostering mutual relationships and effective participation. A study done by Akinyemi et al. (2019) discovered that, to enhance their professional development, teachers in the high schools, which were the focus of the study, needed to engage in collaborative learning activities within CoPs. In a separate study, Tannehill and MacPhail (2017) carried out a continuous longitudinal investigation focusing on the professional development of a group of physical education teachers within an Irish physical education CoP, comprising educators exclusively from inner-city disadvantaged schools. Their findings underscore the mutual assistance that the teachers such as these extended to each other, the sense of agency that they had cultivated to tackle the difficulties arising from their demanding work environments (such as inadequate resources, unfavourable economic circumstances, and students exhibiting problematic conduct), and the impetus that their participation in a CoP had given them to persist in teaching under challenging circumstances (Tannehill & MacPhail, 2017).

Qi and Wang (2018) conducted a study to investigate the development of CoPs among language teachers for the purpose of their professional growth and facilitated by an online chat group. The digital chat forum offered a diverse range of communication modes, including written, auditory, and visual, to facilitate both individual and collective exchanges. The establishment of an online CoP by these teachers resulted in the emergence of mutual engagement, with rapport building being a notable highlight. The study conducted by Qi and Wang (2018) also revealed that the online group chat among teachers exhibited indicators of mutual engagement, such as the establishment of a valuable space for engagement, the cultivation of warm and supportive relationships, the expression of care for one another, the development of trust, and the fostering of a strong sense of belonging. The evidence presented in this section indicates that a sense of inclusion in important matters is crucial for members of a CoP to feel a sense of belonging. Additionally, these studies found that fostering community engagement required promoting diversity and partiality. Thus, from this one could argue that participation in mutual activities necessitates not only individual proficiency but also the competence of other involved parties. However, in view of all that has

been mentioned so far, one may argue that the CoP social learning theory fails to acknowledge objectivity. Drew (2023) agrees with this point of view, arguing that the CoP social learning theory does not recognise that individuals may acquire objective information via self-directed learning in the same way as cognitive constructivism does (see Table 3.1). Furthermore, Drew (2023) contends that this theory does not adequately account for the specifics of the process of learning since it is obvious that individuals may learn independently of one another. Barton and Tusting (2005) point out a second key flaw in the CoP social learning theory, namely that it fails to take into consideration the broader social structures and power relations in society, as illustrated in Table 3.1. Howlett et al. (2016: 743) agree with this criticism, stating that "while CoPs do not have defined hierarchy or leadership roles, the implementation of the process does require a champion to promote the CoP and engage participants." Fuller, Hodkinson, Hodkinson, and Unwin (2005) explored how unequal power dynamics inside a CoP can impact group members' ability to learn from one another. Those in positions of authority are the ones who are in a position to allocate resources, hence dictating the level of membership in the organisation. Although Wenger (1998) did mention this, the issue was not thoroughly investigated in his work.

3.2.1.2. Shared repertoire

Over time, sustained mutual engagement within a CoP leads its members to cultivate a collective repertoire encompassing language, artifacts, tools, narratives, approaches, and concepts (Wenger, 2000). The assertion made by Wenger (2000) aligns with the research conducted by Xu and Ko (2019). Their study (Xu & Ko, 2019) involved a case analysis of a comprehensive professional development initiative for in-service teachers in three schools located in Hong Kong. The results demonstrated that mutual engagement facilitated the co-creation of a shared repertoire among the participating teachers. This shared repertoire pertained to the purposeful use of specific teaching materials and strategies to enhance the teaching and learning process. As community members interact through their socially constructed practices, they cultivate a shared repertoire comprising "routines, vocabulary, tools, methodologies, narratives, gestures, symbols, genres, actions, or ideas that the community has generated or embraced over time, and that have become integral to its practice" (Wenger, 1998: 83). These communal resources, or shared repertoire, are then used by the community members for the benefit of the CoP as a whole. Qi and Wang (2018) discovered in their study that the aim of teachers in online group chats was to provide effective support for student learning in flipped classrooms, using synchronous and asynchronous functions on the

online group chat, with teachers actively engaged in collaborative discussions and reflections on their teaching experiences, as well as student feedback and performance.

Moreover, Qi and Wang (2018) reported that, through engaging in a collaborative learning process, the participants were able to cultivate new pedagogical approaches and enhance their professional skills. Thus, from this and other studies, it can be seen that WeChat, the digital platform for group communication, has expanded the prospects for educators to obtain a broader range of resources for their professional growth and advancement. Likewise, in a separate study Lantz-Andersson et al. (2017) found the presences of a teacher professional Facebook group, functioning as a CoP to encompasses collective knowledge and skills related to improving teaching practices which included strategies for addressing localised teaching challenges and exchanging insights on the effective utilisation of instructional tools. The existing literature on the concept of shared repertoire suggests that a shared repertoire is the outcome of diverse activities that are undertaken to accomplish the goals of the organisation. This viewpoint is echoed by Besamusca (2013). Given the importance of the issues they address, it is unsurprising that CoPs tend to place a high degree of importance on the shared repertoire of shared resources. On the other hand, regarding the shared repertoire of a CoP, Weatherby (2017) criticises the CoP social learning theory by arguing that the theory suggests that members may not welcome outsiders if they are too territorial in terms of their domain and practice, or if the language of the community is too precise or sophisticated for them to grasp, shown in Table 3.1.

3.2.1.3. Joint enterprise

Ultimately, members of the CoP engage in joint enterprise. According to Wenger (1998; 2000), a joint enterprise refers to the recognition of shared practices and the identities of oneself with the collective identity of the CoP to which one belongs. According to Mortier (2020), joint enterprise, also known as domain, is the common objective that motivates members to engage and collaborate with one another. This objective not only encourages their involvement and contribution, but also directs their educational pursuits and imbues their endeavours with significance and value (Mortier, 2020). Friedrichsen and Barnett (2018) argue that a CoP is established when learning takes place as a result of mutual engagement in joint enterprise. Despite the potential for diversity in backgrounds and perspectives among community members, their collaborative efforts constitute a joint enterprise that necessitates shared accountability, even as they may be subject to external

influences. It is through the members of the community interacting with one another inside the community that joint enterprise is established. Through these interactions, the members of the community come to a mutual understanding, one which serves as the glue that binds them together (Wenger, 1998; Besamusca, 2013). Joint enterprise provides members of a community with a common goal, which strengthens their sense of belonging to the group as a whole (Jho et al., 2016). In the same vein, Phillips (2014) notes that members of a CoP work together to collectively react to the requirements and objectives of the organisation as part of the CoP's joint enterprise. Cobb, McClain, De Silva Lamberg, and Dean (2003) provided an illustration involving secondary school Mathematics teachers. These teachers' common goal was to ensure that learners understand fundamental Mathematical principles and concepts and achieve strong performance in Mathematics assessments. Therefore, as was underlined by Besamusca (2013), the objective of the enterprise ought to be the product of a collective process of discussions, and which should reflect the entire complexity of the mutual interaction. The most essential implication that can be drawn from this is that it is crucial that every member be capable of contributing in some way to the accomplishment of the overall objective.

The present study draws on Wenger's (1998) social theory of learning within a CoP to gain a deeper understanding of the approaches employed by in-service teachers when they form hybrid CoPs for the shared purpose of developing their TPACK. Specifically, the study examines the three dimensions of CoP, namely mutual engagement, shared repertoire, and joint enterprise as they relate to the aim of the study. The data underwent analysis based on themes (sub-dimensions) that surfaced in connection to each of the three (*n=3*) dimensions of CoP, as depicted in Figure 3.1. The themes were instrumental in addressing the very first subsidiary research question, namely: *What innovative approaches to form hybrid CoPs are being used by participant primary school in-service teachers in developing their TPACK?* I concluded that it was essential to first understand how these participating teachers constructed their hybrid CoPs via a 'natural' process, as well as how these teachers were using these informal communities as a resource for their professional development, specifically to increase their TPACK. This was in order to get a complete understanding of the nature of the impact that hybrid CoPs have on teachers' professional development. Since the main purpose of this study was to gain a better understanding of the influence that hybrid CoPs have on the development of a sampled group of primary in-service teachers' TPACK, it was essential that the focus not simply be on how hybrid CoPs are formed (as

was previously explained, it is a given that CoPs are formed through mutual engagement, joint enterprise, and shared repertoire), but also on how new knowledge (TPACK) can be gained during the process of learning within hybrid CoPs, a process defined by Wenger (1998). I discuss this in more detail in the following section.

3.2.2. Four components of learning in a CoP

According to Wenger (1998), there are four distinct components of learning present within a CoP. These elements include Community (which involves learning through a sense of belonging), Practice (which involves learning through doing), Meaning (which involves learning through experience), and Identity (which involves learning through becoming). The interconnection between the learning process, negotiation of meaning, and changing identities suggests that community members in the context of a CoP transition from a passive role to an active one, engaging in interactive participation within a shared practice (Mortier, 2020). The theoretical framework systematically examines the intersection of these learning components, which in turn serves as a basis for analysing learning as a form of social participation (Wenger, 1998). The components can be seen in Figure 3.2 presented below.

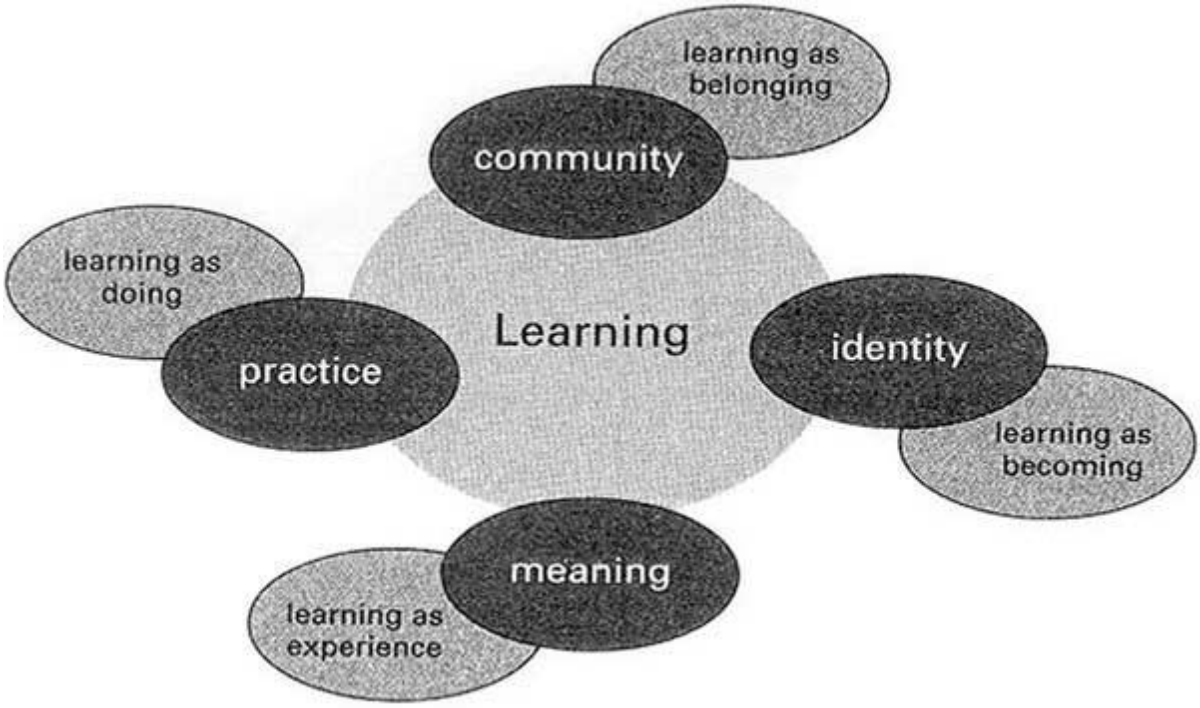

Figure 3.2: Social theory of learning (Wenger, 1998: 5)

3.2.2.1. Practice

According to Wenger (1998), the concept of practice refers to the historical and social resources, structures, and perspectives that facilitate mutual engagement in action. As per Wenger's (1999) assertion, the act of practice engenders a collective history of acquired knowledge. History is not limited to personal or collective experiences, or to a mere collection of long-lasting artifacts and solutions; rather, it is a complex amalgamation of participation and reification that is interwoven over a period (Wenger, 1999: 87). Lave and Wenger (1991) argue that engaging in a CoP entail participating in the socialisation process of the community, whereby an individual gradually assimilates the language, customs, and techniques of the community through active involvement. Wenger (2011: 2–3) posits that communities cultivate their practice through a diverse range of activities, including, but not limited to, problem-solving, information-seeking, experiential learning, asset reutilisation, coordination and synergy, discourse on advancements, documentation initiatives, site visits, knowledge mapping, and identification of gaps. An example of a space where some or all of these would come into play would be in the context of collective problem-solving strategies.

Basing their arguments on CoP social learning theory, Batchelor (2020) and Cotter et al. (2017) saw members of a CoP as engaging in the exploration of ideas, discussions of circumstances and needs, and collaborative problem-solving. Similarly, Holland (2018) holds the view that a robust CoP is characterised by the development of collaborative practices among its members, enabling them to collectively generate problem solving strategies and effectively address problems related to their practice. However, according to Phillips (2014), practice is more than the sum of the activities that we carry out. It is both how we see the world around us and how we engage with the events that take place in that world. In a subsequent study, Stănescu, Andronache, and Böhmer (2022) backed up this idea, arguing that it is important to evaluate not only the rational and objective aspects of an issue or dispute, but also the subjective aspects, such as the feelings and wants of all parties involved. Additionally, Stănescu et al. (2022) argue that, in order to resolve a disagreement amongst or between members of a group, both sides need to confront the issue head-on and attempt to engage in conversation with the opposing side. Given the aforementioned viewpoints, it can be inferred that practices are patterns of socially recognised activities that are imbued with knowledge and meaning. These practices are deeply embedded within communities, routines, and organisations, and serve to structure individuals' experiences (Græger, 2016).

3.2.2.2. Meaning

According to Krzywoszynska (2019), a CoP is characterised by a collective engagement in a set of activities that are imbued with a shared system of meaning. This joint enterprise confers significance and value to the activities, thereby uniting the members of the CoP. As per Wenger's (1999) assertion, the encounter with this significance is not a result of spontaneous generation, nor is it a mere automated execution of a customary or a methodical process. Wenger (1999) adds that individuals' involvement in a particular activity may exhibit certain patterns; however, it is the process of the creation of these patterns that leads to a sense of meaning. Weinberg, Balgopal, and McMeeking (2021) provide support for Wenger's (1999) concept of meaning by contending that individuals actively participate in the figured worlds within their surroundings and transfer their experiences and comprehension from one setting to another. These understandings are utilised to construe and establish significance across all contexts. Wenger (1999: 53) further argues that individuals exist in a perpetual state of negotiating meanings. The concept of "negotiation of meaning" encompasses various aspects, such as language usage, the attainment of consensus, and the execution of a task that necessitates sustained attention and modifications (Wenger, 1999). He sees CoPs as distinguished by an ongoing process of meaning negotiation, wherein members strive to collaboratively comprehend and assign significance to their shared experiences (Wenger, 1998). This activity of constructing meaning encompasses two significant facets. In the context of a school, members of the teaching staff may be intimately familiar with their counterparts, yet they continue to engage in repeated dialogues. While all that they do and say may refer to what has been done and said in the past, they create an entirely new situation, together with new impressions, and experience. Stănescu et al. (2022) contend that communication is the foundation upon which both the formation of relationships and the organisation of societies are built. Every member of the group is acquainted with the particular appropriate communication patterns and codes that emerge inside the group and that are relevant to the situation. These codes and patterns serve to identify members of a group and to define its borders (Stănescu et al., 2022). Within, and generated by this pattern, individuals generate meanings that extend, redirect, reject, reinterpret, modify, or confirm the meaning histories of which they are a part (Wenger, 1999). The primary benefit of this practice is its contribution towards the CoP's internal development, thereby facilitating continuous learning. Additionally, this pattern or process enables the CoP and its members to establish their position in relation to other communities, as noted by Krzywoszynska (2019: 165). Based on the

combined evidence as provided from the literature in this section, one could argue that the CoP social learning theory is most successful when its members meet often enough to enable the process of continuing meanings by means of repeated dialogues. However, Philander (2018) has critiqued this theory in the context of schools, as shown in Table 3.1, by pointing out that it is not always feasible for teachers to meet on a regular basis as this theory would require from CoPs, mainly because of practical issues such as the large distances between schools, a particularly problematic issue in rural regions (Philander, 2018). Thought needs to be given to alternatives to the traditional method of holding regular in-person meetings if CoPs are to be run efficiently and sustainably. In this context, and as a solution to this practical problem, Magnusson and Godhe (2019) claim that the use of digital technology has enabled the amalgamation of resources and has both eased and helped to sustain the process of producing meaning across various modalities and media, thus providing significant support for CoP members.

3.2.2.3. Community

A community is a social arrangement characterised by the definition of individuals' initiatives and the acknowledgment of their competence in participation (Wenger, 1998). Wenger (1998) elucidates this definition: distinct communities are formed through the shared experience of a sense of belonging among their members. Expanding upon Wenger's (1998) definition, Strayhorn (2018: 4) defines belonging as "a sense of connection and the perception of being valued or cared for...by faculty, staff, and peers." According to Wenger's (1998; 2010) proposition, instead of assigning communities to predetermined categories, it is more appropriate to examine the various modes of belonging, such as engagement, imagination, and alignment, in order to comprehend the formation of diverse communities. These modes may lead to the development of community members' confidence. To exemplify the significance of the concept of belonging, Graven (2004) conducted a study on Mathematics teacher learning within an in-service CoP. The study revealed that confidence emerged as both an outcome and a progression of the learning process, one which facilitated the transition of the teachers from being mere teachers of Mathematics to becoming competent and confident Mathematics teachers. Patton and Parker (2017) confirmed this finding in their research, which examined the perceptions of physical education teacher educators regarding the impact of their involvement in a CoP on their professional growth. Their study yielded intriguing results. As colleagues were engaged with each other in discussion, thereby

reducing isolation, a heightened sense of confidence emerged, which subsequently facilitated the recognition of potential to become better Mathematics teachers. The sense of belonging evoked by membership of the CoP under study led to the establishment of reliable relationships that helped to alleviate the sense of academic isolation among the participants (Patton & Parker, 2017). As proposed by McLaughlin and Talbert (2010: 37), a community can consist of both a significant number of experienced, proficient teachers and novice teachers. This composition ensures that the group possesses the essential elements for teacher learning to take place. Through this process, teachers cultivate a sense of belonging, as depicted in Table 3.1 on page 114. In the course of research he conducted on college students Nunn (2021) found that students who possess a sense of academic belonging have the confidence to actively engage in classroom discussions by asking questions or offering remarks. Furthermore, these students easily joined study groups without harbouring concerns about failing their classmates. Hence, this would also suggest that educators who perceive and experience a strong feeling of belonging within their CoPs would be less inclined to feel ashamed or hesitant when seeking assistance from their peers on the integration of technology in their teaching practices. In line with contexts described in this section, Michalski, Diemert, Helliwell, Goel, and Rosella (2020) assert that community membership and participation improves quality of life, resulting in a stronger feeling of identity and confidence, than would anonymity and loneliness. Mustikawati and Tarwiyah (2022) add that belonging to a community entails the capability to support teachers' transformational practices and creativity. These practices include identity development, relationship-building, and the creation of social structures. In a school context, a social structure may include a committee specifically dedicated to ICT matters inside the school. This idea aligns with the conclusions obtained by Razzak (2015) from his findings on a study on ICT incorporation in teaching in Bahrain schools. The argument made by Razzak (2015) posits that the effective implementation of digital teaching by educators necessitates the establishment of support structures that enable educators to raise their ICT proficiency levels and confidence. Collectively, these studies offer significant perspectives on the notion that a shared profession alone does not constitute a community, unless its members engage in mutual interactions and knowledge acquisition and sharing, and in this process, members experience a sense of belonging.

3.2.2.4. Identity

The process of forming identity through engagement in and learning from the activities of a community is another subject initially investigated in Lave and Wenger's (1991) work and expanded upon in Wenger's later writings (1998). Wenger emphasised that as individuals engage in a CoP and gain new knowledge, their identities evolve concurrently. As a result, participation in a CoP leads to shifts in individuals' perceptions of themselves and their sense of identity. As per Wenger's (1998) assertion, the concept of Identity can be characterised as a process of acquiring knowledge through the act of becoming. Wenger (1998) further points out that the term "identity" can be utilised to enable a sociological analysis of an individual's position within a group. In this context, the process of identity formation is negotiated through participation and reification, much like the ways in which practices are negotiated (Wenger, 1998). Similarly, Cuddapah and Clayton (2011: 64) assert that individuals acquire, modify, and relinquish identities through their participation in CoPs, which are environments where personal and shared interpretations are generated. This assertion is supported by Phillips (2014) who describes a CoP as a dynamic environment that offers, not only access to expertise for newcomers, but also an opportunity for them to engage in a distinctive experience of participation, one which enables them to integrate their newly acquired knowledge into their sense of identity as engaged members of the community. Therefore, in return, as argued by Wenger (1998), the development of a strong sense of identity among employees significantly contributes to the enhancement of organisational learning (Wenger, 1998). Wenger (1998) goes on to argue that the process of identity development during learning encompasses more than the mere acquisition of factual information and numerical data. It also involves the cultivation and refinement of one's own personal characteristics and traits. For example, Phillips (2016) sees the development of teachers' TPACK as being influenced by the process of identity development and practice. To add to this concept and process of identity formation through membership of a community, Spanellis and Pyrko (2021) argue that the process of identity formation occurs on two distinct levels. The first pertains to the demonstration of proficiency within a given community and the subsequent recognition of such competence by its members. The second level involves the acquisition of an ability to identify personal characteristics and traits associated with the CoP to which the individual belongs, as posited by Farnsworth, Kleanthous, and Wenger-Trayner (2016). These dimensions are indicative of the continuous and dynamic process of negotiating one's identity. In general, there exists some evidence suggesting

that learning within a CoP is depicted as a social construct of an individual, rather than solely as the assimilation of information. This was also made clear in Pyrko, Dorfler, and Eden's (2017) research findings, from which they concluded that learning necessitates changes in an individual's identity in addition to the re-negotiation of the meaning of experiences gained, as is illustrated in Table 4.1 on page 127.

In the context of a CoP theory of learning, the primary focus of analysis is not on the individual person or the social structures, but rather on the CoPs themselves. In essence, as shown in Table 3.1, Wenger's (1998) theoretical framework emphasises the collective or group as the primary unit of analysis, as opposed to a focus on the individual. In support of this view, Fuller et al. (2005) argue that the significance and value of individuals lies in their ability to acquire knowledge via their interactions with others in a social context. In relation to this idea, the concept of situated learning, specifically within CoPs, might provide a perspective or lens through which one can understand the process of teachers' learning within the socio-cultural environment of their professional settings (Fuller, 2007). Wenger's (1998) theoretical framework is based on the idea that the notions of community, practice, meaning, and identity can serve as a viable analytical tool for examining learning as a form of social engagement (see Table 3.1). According to Wenger (1998), the components are intricately intertwined and have a mutual influence on each other. Furthermore, according to Wenger (1998), it is feasible to substitute any of the four peripheral components with learning and position it at the core as the primary emphasis, without disturbing the coherence of the overarching framework. The concept of valid peripheral participation, as defined by Lave and Wenger (1991), can be readily applicable to both novice and inexperienced teachers who are joining an existing CoP consisting of educators with varying levels of expertise. A practical example of this concept, and one of relevance to the current study, is the idea that, in the context of a pre-existing CoP, it is possible for recently trained in-service teachers to be considered new members in terms of their limited years of teaching experience, but core members regarding TPACK. As Table 3.1 shows, to analyse the intricate nature of such a CoP, Wenger's (1998) multilayered theoretical framework serves as a valuable analytical tool.

The current study utilised the four components of the CoP social learning theory to understand the motivating factors and constraints associated with teachers' learning of TPACK in hybrid CoPs established in public primary schools. This approach proved particularly useful in addressing the

second subsidiary research question, namely: *What are the driving factors and constraints around hybrid CoPs in developing participant primary school in-service teachers' TPACK?* The analysis and categorisation of data was conducted by identifying themes associated with each of the components of the selected CoPs under study, as outlined in this section. The evaluation of the distinct and collective contributions of the four components to the development of TPACK in hybrid CoPs is imperative, considering the current utilisation of such CoPs in schools both in South Africa and in a global context. In the opinion of Stewart (2014), professional development that is active, consistent, grounded in the teaching environment, and reinforced by peers in a learning community is considered effective by educators in terms of achieving its goals. The implementation of a CoP framework in TPD initiatives has the potential to mitigate certain constraints, such as temporal and geographical limitations (Amin & Roberts, 2006). CoPs present a learning framework that has the capacity to optimise the growth and professional development of educators (Lave & Wenger, 1991). Additionally, as shown in Table 3.1, CoPs afford teachers opportunities to acquire knowledge from other experts in the same field (Johnson, Bledsoe, Pilgrim & Lowery-Moore, 2019). In this section, supported by the many studies and discussions of social learning theory in the literature, I justified my choice to employ Wenger's (1998) CoP social learning theory as a primary theoretical framework that functioned as a context in which the relationships of the participant teachers in my study were, and were in the process of being, created while learning TPACK from one another in the context of their respective CoPs. However, as much as Wenger (1998) recognises community members' ties to one another in their CoPs, he failed to explore the phenomenon of the relative and varied strengths of these ties. Accordingly, Granovetter's (1973; 1983) The Strong and Weak Tie Theory related to social networks was used in the current study to address this gap. This was done to measure and compare the quality of these teachers' ties with one another inside their hybrid CoPs in the continuous process of gaining TPACK expertise from one another.

3.3. The natures of Strong and Weak Tie Theory (Granovetter, 1973)

Granovetter, in his 1973 seminal work on social networks, posited that a network should ideally have a combination of strong and weak ties, since the characteristics of these respective ties play a significant role in shaping the functioning and composition of CoPs. To clarify, Granovetter (1973: 1361) categorised social connections into two respective types, namely strong and weak ties, based on the concept of tie strength. Tie strength is described as a composite measure which

includes factors such as the duration of interaction, the depth of emotional attachment, the level of personal closeness, and the extent of mutual exchange between two individuals. Lin (2001) explained that strong ties are found in relationships that are typically observed among individuals who share family or social networks. Historical analyses of strong and weak ties have often yielded the conclusion that strong ties tend to provide people with more advantageous social and psychological resources compared to weak ones (Rademacher & Wang, 2014). The efficacy of their "bonding" function has been particularly acclaimed (Rademacher & Wang, 2014). Thus, in an earlier study, by Lin (2001) strong ties are associated with bonding social capital which is defined by close ties inside one's own peer group.

When people are near one another, such as in families, churches, or neighbourhoods, they are more likely to create bonds of solidarity, reciprocity, familiarity, and trust (Coleman, 1994; Granovetter, 1973). Reciprocity, as defined by Cherry (2023), is the practice of exchanging resources with other people to acquire benefits that are beneficial to both parties. Reciprocity enables individuals to do things that they would not be able to accomplish on their own. People can do more collectively or by exchanging and sharing resources by working together (Cherry, 2023) than they would by working alone. Bhandari and Yasunobu (2009: 21) expand on this by noting that members of the same bonding networks tend to share fundamental personality traits (e.g., class, race, ethnicity, education, age, religion, gender, and political affiliation). Granovetter (1985: 490) pointed out that the information and support that can be obtained through strong ties offers a variety of advantages, including: it is inexpensive; it is more trustworthy because it is richer, more detailed, and more accurate. Contrastingly Hu, Wang, Jiang, and Yang (2019) argue that strong ties also have a weakness that may be categorised as either informational or structural. Since individuals who have strong ties often have similar hobbies, occupations, or geographical locations, there is a tendency for knowledge that is passed along the strong ties to be of no value to the other members of a network; this is thus an informative weakness. The concept of transitive closure displays structural weakness. In the context of a friendship network, for instance, this indicates that the acquaintances of a particular individual are also mutually connected with each other, and it is difficult for information to disseminate from such confined triads to outside parties (Hu et al., 2019).

One of the primary applications of Strong and Weak Tie Theory is in the world of interpersonal connections. In particular, it argues that people should work to strengthen their weak ties in order to increase their exposure to new ideas and opportunities (Granovetter, 1983). Hu et al. (2019) further stressed the importance of weak ties, not only for providing significant and helpful information, but also serving as vital bridges across which information may move and spread swiftly and widely in a network, as shown in Table 3.1. Thus, Lin (2001) claimed that weak ties were relied on more for informational purposes and may be seen as transient and less intimate connections that occur among individuals from diverse backgrounds and subcultures. A person's weak relationships provide them with access to more individuals and more resources in their community (Erickson, 2004; Lin 2001). Granovetter (1973) claimed that weak relationships play a crucial role in facilitating connections across various social groups, therefore serving as a valuable "bridging" mechanism. Bridging, according to Lin (2001), is defined by ties between people in various social groups. When individuals from different social circles work together to exchange information, ideas, and physical space, they build bridges of weak ties. Moreover, Terrell Hanna and Wigmore (2023) argue that people might benefit from gaining access to previously unavailable information and opportunities by actively using social media platforms to develop weak ties (shown in Table 3.1). According to this hypothesis, therefore, fostering communication and cooperation across different CoPs is likely to boost information sharing, which in turn fosters innovation and creativity (Granovetter, 1985).

Bhandari and Yasunobu (2009) believe that bridging refers to less tightly bound relationships of like-minded people, such as casual friends and coworkers. Therefore, a form of bridging seems to be essential for resolving community issues, since it facilitates getting to know one another, establishing ties, exchanging information, and mobilising community resources (Granovetter, 1973). Henttonen, Johanson, and Janhonen (2014) argue that, by using bridge social networks that include a varied group of external team members, organisations may access a wide variety of information and expertise, ultimately leading to increased effectiveness of the group in terms of members acquiring knowledge and expertise. Teams whose members engage in social interactions with individuals from diverse backgrounds are likely to acquire knowledge about organisational advancements at a rapid pace. In the event of encountering a setback, these teams are more inclined to have access to a wide range of emotional and political support through their connections with other networks (Henttonen et al., 2014). As shown in Table 3.1, the evidence presented in this

section suggests that Granovetter's (1973) theory appears to focus, and to place more emphasis on the aspect of information, paying less attention to the emotional aspect of social ties. Granovetter's (1973) theory thus falls short in explaining how social ties are dynamic and may change over time depending on the nature of networks.

According to Granovetter (1973), strong and weak ties, are both important because they connect individuals to valuable resources (e.g., information and/or opportunities) (see Table 3.1). This current study utilised Granovetter's 1973 Strong and Weak Tie Theory to investigate the types and strengths of ties derived from the participant in-service teachers' interactions with one another within their respective hybrid CoPs in the process of their acquiring TPACK. Specifically, the research aimed to gain insight into how the social ties of these teachers had evolved, taking into consideration the COVID-19 pandemic. Strong and Weak Tie Theory was applied in the current study in order to address the third subsidiary research question*: What was the nature and degree of the strengths of these in-service teachers' relationships in their hybrid CoPs while they were in the process of learning TPACK from one another during the recent COVID-19 pandemic?* The data pertaining to the third question was classified based on the principles of bonding and bridging. This was done to assess and contrast the degree of strength of the relationships among these teachers while they were in the process of acquiring TPACK from one another within their hybrid CoPs prior to, and during, the COVID-19 outbreak. This analysis was conducted with a specific focus on the words in the vocabulary that delineate these categories, as previously demonstrated in this section. As shown in Table 3.1, while this framework is designed to recognise that employees may share information in the workplaces, it does not specify what type of information. Consequently, the adaptability of this framework enables researchers to investigate a wide range of knowledge domains. Thus, the present study employed the TPACK framework developed by Mishra and Koehler (2006) to understand and analyse the distinct nature of the knowledge that the participant in-service teachers gained or shared within their respective hybrid CoPs.

3.4. The nature of TPACK model (Mishra & Koehler, 2006)

Mishra and Koehler (2006) and Koehler and Mishra (2009) contend that in order for educators to proficiently integrate technology into their teaching practices, they must possess a comprehensive understanding of the technological, pedagogical, and content-related dimensions specific to the

subject matter they teach.TPACK, as shown in Figure 3.3, is a synthesis of these three bodies of knowledge.

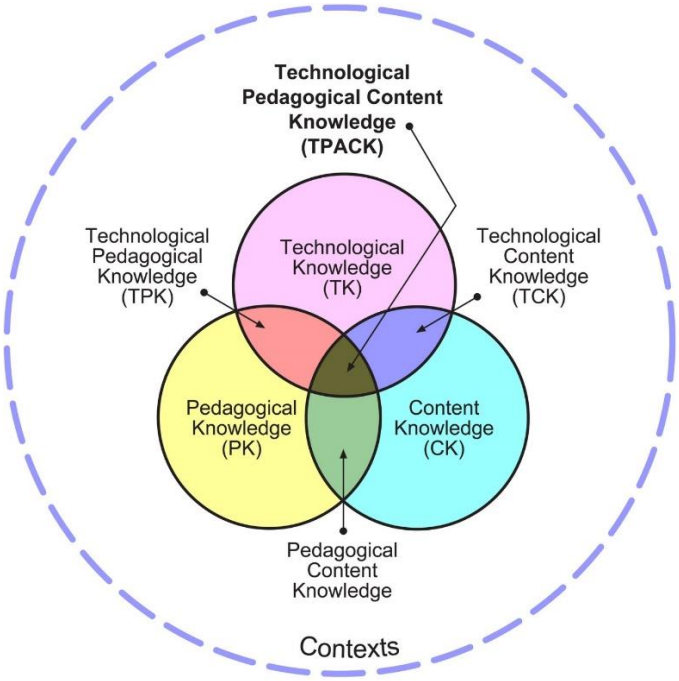

Figure 3.3: TPACK model (Koehler & Mishra, 2009: 63)

As can be seen in Figure 3.3, the model has seven distinct areas of knowledge due to the overlap between the three circles representing content, pedagogy, and technology. In order for teachers to successfully incorporate technology into their lessons, there needs to be cooperation between seven distinct areas of expertise (Koehler & Mishra, 2009; Koehler & Mishra, 2012; Mishra & Koehler, 2006; Taopan, Drajati & Sumardi, 2020): technological knowledge (TK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), and technolog pedagogical and content knowledge (TPACK). In order to provide a broad overview of the TPACK model, the following section focuses on explaining in depth these seven areas of knowledge which together constitute TPACK.

3.3.1. Technological Knowledge (TK)

TK refers to the understanding and acknowledgement of technological capabilities and possibilities. Valtonen, Leppänen, Hyypiä, Sointu, Smits and Tondeur (2020) define TK as the knowledge required to effectively navigate the rapid pace of technological advancement, with a focus on adaptation rather than on traditional teaching and learning methods. TK encompasses both traditional media like books and chalkboards and modern media such as the Internet and digital video recorders (Koehler & Mishra, 2012; Mishra & Koehler, 2006; Zhang & Tang, 2021). Possession of this knowledge necessitates familiarity with various computer operating systems and hardware, proficiency with commonplace applications like word processors, spreadsheets, web browsers, and electronic mail, and the ability to set up and take down hardware and software, create and store documents, and delete and restore files (Mishra & Koehler, 2006; 2011). This expertise has variously been referred to as digital literacy, digital fluency, and computer literacy (Chigona, 2018). Since technological developments are ongoing, Mishra and Koehler (2006) maintain that TK must also evolve through time. Eighteen years ago, they foresaw many of the tools (word processors, browsers, etc.) as likely to undergo significant transformations or possibly vanish entirely in the future (Mishra & Koehler, 2006). No matter what form future technologies take, the capacity to learn and adapt to them will remain crucial.

3.3.2. Pedagogical knowledge (PK)

PK refers to an in-depth understanding of the procedures, practices, or techniques of teaching and learning, as well as the ways in which this understanding incorporates, among other things, the larger educational objectives, values, and goals (Koehler & Mishra, 2009; Mishra & Koehler, 2006; Koehler & Mishra, 2008; Zhang & Tang, 2021). Valtonen et al. (2020) reported in a recent study that PK encompasses the understanding of classroom management and assessment, as well as knowledge pertaining to the ways in which learners construct knowledge. Roussinos and Jimoyiannis (2019) assert that the focus of PK is on learning theories in a general sense, rather than on the teaching of specific content. This is a general kind of knowledge that is engaged in all aspects of learner learning, classroom management, the creation and execution of lesson plans, and the assessment of learner performance. Graham (2011) and Mishra and Koehler (2006) argue that a teacher who has a strong understanding of pedagogy knows how learners create information, gain skills, and establish learning habits as well as positive attitudes about learning. Thus, having pedagogical knowledge includes having a grasp of the cognitive, social, and developmental

theories of learning as well as how these theories are applicable to learners when they are in the classroom (Mishra & Koehler, 2006).

3.3.3. Content knowledge (CK)

CK is knowledge of the real subject matter that has to be acquired or taught (Koehler & Mishra, 2009; Mishra & Koehler, 2006; Roussinos & Jimoyiannis, 2019; Shulman, 1986; Zhang & Tang, 2021). Valtonen et al. (2020) describe CK as encompassing the fundamental knowledge of disciplines without considering the pedagogical aspect of teaching the subject matter. Possession of this knowledge. includes being able to understand the fundamental facts, concepts, theories, and procedures that are central to a particular field; understanding the explanatory frameworks that organise and connect ideas; and having an understanding of the norms governing the presentation of evidence and proof (Shulman, 1986). This basically signifies that teachers need to be knowledgeable about, and understand, the topics that they teach their learners. Educators who do not have these understandings are at risk of giving their learners an inaccurate picture of the subject knowledge of a variety of areas (Cox, 2008).

3.3.4. Technological Pedagogical Knowledge (TPK)

TPK is defined by Taopan et al. (2020) and by Valtonen et al. (2020) as the act of acquiring an understanding of how to effectively utilise technology to support specific pedagogical approaches, as well as an understanding of the advantages and limitations of various technologies in pedagogy. Several characteristics of TPK, and the advantages associated with its use, may all fall into this category. These include knowledge of pedagogical techniques, and the capacity to use such techniques for use of technologies, as well as the ability to choose an appropriate tool based on its fitness for curriculum delivery, and on the appropriateness of strategies for making effective use of the tool's affordances. In a nutshell, TPK refers to an educator or policy maker being aware of how lessons and classroom dynamics can change when technology is included (Block, Cleary, Fairfield, Henderson, Kuk, Perschall & Ramalingam, 2015). Thus, as pointed out by Koehler and Mishra (2009), TPK necessitates an innovative, open-minded, and forward-thinking pursuit of technology usage, not for the purpose of developing technology itself, but rather to advance student learning and comprehension.

3.3.5. Technological Content Knowledge (TCK)

Roussinos and Jimoyiannis (2019) and Valtonen et al. (2020) have provided a more comprehensive definition of TCK, which encompasses an understanding of the interplay between technology and content, as well as familiarity with the various technologies employed in different subject domains. Valtonen et al. (2020) assert that TCK pertains to the understanding of how subject matter evolves alongside technological advancements, independent of pedagogical considerations related to the instruction of the content domain. As argued by Mishra and Koehler (2006), Koehler and Mishra (2009) and Slough and Connell (2006), teachers need to know more than just the content they are covering in class; they also need to know how different technologies might affect various aspects of that content. To illustrate how technology and content may be understood as interdependent parts of teaching and learning, Mishra and Koehler (2006), and Roussinos and Jimoyiannis (2019) reiterate that it is important for educators to have a firm grasp on the technologies that are most useful for addressing subject-matter learning in their respective fields, as well as how the content influences and, in some cases, alters the nature of those technologies.

3.3.6. Pedagogical Content Knowledge (PCK)

PCK refers to the ability to convert subject matter expertise into effective teaching strategies and to create conducive learning environments that facilitate the acquisition of specific content knowledge (Valtonen et al., 2020). In accordance with Taopan et al. (2020), PCK refers to the knowledge that teachers possess regarding the implementation of diverse teaching strategies for the purpose of conveying subject matter. A part of this knowledge, is the knowledge teachers may possess regarding which methods of teaching are most appropriate for this task, as well as how to best organise various aspects of the content for pedagogy (Koehler & Mishra, 2012; Mishra & Koehler, 2006). Similarly, Koehler and Mishra (2009) point out that knowledge of what makes ideas difficult or easy to learn, knowledge of learners' previous knowledge and experience, and theories of epistemology, all play a role in what is known as PCK. This knowledge also considers how concepts are represented and formulated in the classroom. It is important not to forget that, as Mishra and Koehler (2006) point out, that it also involves an understanding of the prior knowledge and experiences of the learners Their prior knowledge may, however, be useful or counterproductive depending on the nature of the learning activity at hand.

3.3.7. Technological Pedagogical and Content Knowledge (TPACK)

Graham (2011: 10) explains that TPACK is an emerging type of knowledge that goes beyond a single focus on technology, content, or pedagogy, and instead considers the interplay between these three facets of teaching. According to Roussinos and Jimoyiannis (2019), the effective utilisation of technological tools to teach specific subject matter requires an understanding and application of the three constitutional domains, along with specific pedagogical methods and strategies. This integrated body of knowledge and skills is aimed at achieving the desired learning outcomes in a meaningful, constructive, and efficient manner. As defined by Roussinos and Jimoyiannis (2019), TPACK is a comprehensive model of teacher knowledge that elucidates the essential factors that influence successful teaching and improved learning outcomes when utilising digital technologies. Therefore, this paradigm for incorporating technology into classroom teaching contends that pedagogy, content, and technology must all be carefully woven together in order to provide high-quality teaching content (Mishra & Koehler, 2006). There is a dynamic equilibrium between the TPACK model's three major components (technology, content, and pedagogy) that makes disentangling them difficult in practice (Koehler & Mishra, 2012; Mishra & Koehler, 2006), as Table 3.1 illustrates. In the same vein, as shown in Table 3.1, Foulger, Wetzel, Lindsey, Buss and Pasquel (2016) reiterate that the TPACK model is too theoretical or abstract for practical application. However, oversimplified solutions or failure might result from disregarding the complexity inherent in each knowledge component, as pointed out by Koehler and Mishra (2009). Koehler and Mishra (2009) agree that TPACK implies a criticism of techno-centric methods that prioritise the acquisition of technological skills separate from pedagogy and content, and they restate that, the use of the TPACK model implies, or ensures, that an educators' knowledge is valued for all its complexity and variety, as is illustrated in Table 3.1. Yeh, Chan and Hsu (2021) strongly support the view that TPACK provides individuals with opportunities to work as a team. They contend that the contextualised essence of TPACK implies that teachers must amalgamate various knowledge reservoirs, often shared among a team of educators. In this current study I used the TPACK model by Mishra and Koehler (2006) as a supplementary framework to CoP social learning theory to understand the specific types of knowledge that the participating primary school teachers were learning and sharing in their hybrid CoPs. Table 3.1 below provides a summary of the strengths and weaknesses of the theoretical frameworks discussed above and which underpin

this current study. These frameworks include CoP social learning theory, Strong and Weak Tie Theory, and the TPACK model.

Theoretical frameworks	Strengths	Weaknesses
1. CoP social learning theory (Wenger, 1998)	• It helps to understand the process of how CoPs may be formed (Wenger, 1998). • Emphasises the collective or group as the primary focus of inquiry rather than the individual (Wenger, 1998). • Provides perspective through which one can understand the process of teachers' learning within the socio-cultural environment of their professional settings (Fuller, 2007). • To analyse the complex nature a pre-existing CoP with new or novice members as experts, Wenger's (1998) multilayered theoretical framework serves as a valuable analytical tool.	• Does not recognise that individuals within the group may acquire objective information via self-directed learning in the same way as cognitive constructivism does. • Fails to take into consideration the broader social structures and power relations in society (Barton & Tusting, 2005). • The successful execution of the CoP process necessitates the presence of a champion or leader who advocates for such a community and actively involves participants. • Members may not welcome outsiders if existing members are too territorial of their

		domain and practice, or if the language of the community is too precise for them to grasp (Weatherby, 2017). • Teachers may find it challenging to meet regularly as required by CoPs due to various constraints (Philander, 2018). • The ability to sustain benefits from a CoP is dependent on the characteristics of the roles of key people involved in building and facilitating a CoP (Whitehead, 2010). • Wenger (1998) acknowledges community members' ties with one another; however, he failed to explore the phenomenon of the strength of ties.
2. The Strong and Weak Tie Theory	• Good for a depth study of the strengths of strong and weak ties.	• Only explains the strength of ties between individuals within CoP

(Granovetter, 1973)	• Strong and weak ties, according to Mark Granovetter (1973), are both important because they connect individuals to valuable resources (e.g. information or opportunities). • It argues that people should work to strengthen their weak ties in order to increase their exposure to new ideas and opportunities (Granovetter, 1983). • Encourages collaboration across different CoPs (Granovetter, 1985). • It encourages the utilisation of social media platforms to gain access to previously unavailable information (Terrell Hanna & Wigmore, 2023).	and fails to explain how CoP may be formed nor how learning takes place within a CoP. • Granovetter's (1973) theory appears to have put more attention on the aspect of information and paying less attention on emotion aspect of social ties. • Granovetter's (1973) theory falls short in explaining how connections are dynamic and subject to change throughout time. • It recognises that employees may share information in the workplaces; however, it does not specify what type of information.
3. TPACK model (Mishra & Koehler, 2006)	• Coutinho and Lisbôa (2013) uncovered that the TPACK model	• Is too theoretical or abstract for practical application (Foulger,

	could offer practical support in designing professional development programmes and fostering teachers' self-assurance to become independent learners by engaging in CoPs. • The TPACK model delineates the competencies and expertise that educators must possess to proficiently incorporate technology into their teaching methods. • TPACK model allows individuals to work as a team. Teachers have the autonomy to gather various information resources, which are often exchanged among a group of teachers (Yeh, Chan & Hsu, 2021). • (Yeh, Chan & Hsu, 2021). • With the TPACK model, educators'	Wetzel, Lindsey, Buss & Pasquel, 2016; Koehler & Mishra, 2012; Mishra & Koehler, 2006). • Assumes technological skills alone automatically lead to integration.

	knowledge is valued for all its complexity and variety. • Can be applied in different learning context	

Table 3.1: Strengths and weaknesses of CoP social learning theory, Strong and Weak Tie Theory, and the TPACK model

The following section offers explanations of the various ways in which these theoretical frameworks may be connected together for the purpose of researching the influence of hybrid CoPs on the development of teachers' TPACK. To be more explicit, the section explains how prior research has employed a mix of and/or one of these theoretical frameworks to look at the circumstances in which teachers gain essential knowledge from one another.

3.5. CoP context and TPACK development

The present section is dedicated to a critical analysis of Wenger's (1998) concept of CoP as a context in which individuals establish either strong or weak ties (Granovetter, 1973) while learning TPACK from one another (Mishra & Koehler, 2006). It is important to mention that my intention was not to provide a critical evaluation of these frameworks. Upon reviewing the existing literature on workplace learning, I concluded that the CoP social learning theory and the Strong and Weak Tie theory would be suitable frameworks for exploring the specific CoP context in which TPACK was being developed among a sampled group of in-service teachers. Coutinho and Lisbôa (2013) demonstrated the practical utility of the TPACK model in shaping professional development training, empowering teachers to effectively incorporate technology in their classrooms, and fostering their self-assurance as independent learners through engagement in CoPs. Additionally, I acknowledge Mishra and Koehler's (2006: 1029) recognition of the contextual importance in the advancement of teachers' TPACK skills:

> The core of our argument is that there is no single technological solution that applies for every teacher, every course, or every view of teaching. Quality teaching requires

developing a nuanced understanding of the complex relationships between technology, content, and pedagogy, and using this understanding to develop appropriate, context-specific strategies and representations.

Given the importance that researchers such as Mishra and Koehler (2006) and others give to it, the context in which teachers acquire and exhibit their knowledge can be seen to serve as an intersection for these various forms of knowledge. Thus, the utilisation of TPACK model in isolation from context would be insufficient to achieve the principal objective of the research, which is to understand the influence of hybrid CoPs on the development of a sampled group of primary school in-service teachers' TPACK. While they recognise the impact of context on the development of teachers' TPACK, Mishra and Koehler (2006) do not provide a clear explanation of how an environment can be established as a context, nor do they identify the factors that may serve as motivators or barriers to community's potential for enhancing the TPACK of in-service teachers. For the current study the CoP framework developed by Wenger (1998) was utilised as the primary framework to investigate the context in which TPACK could be cultivated to address this disparity. Wang (2020) emphasises that a CoP provides a context where educators can collaborate to encourage one another in their effective incorporation of technology into their teaching methods. Phillips (2014) proposed that workplace learning theories, specifically those related to CoP, provide a distinct context for understanding the development of in-service teachers' TPACK. According to Phillips (2014; 2016) and Wenger (1998), a CoP is a fitting framework for situated learning. This framework can be used to investigate the socio-cultural factors that affect both individual teachers' and the communities of teachers' pedagogical technology practices and identity changes. For instance, when Tyarakanita, Nurkamto, and Drajati (2021) conducted a study on a WhatsApp-based online CoP, utilising Wenger's (1998) CoP and TPACK model, they found the development of the TPACK of the teachers in their study to be influenced by CoPs.

In her study, Wang (2020) utilised the CoP framework to investigate the circumstances under which teachers can collaborate to enhance their TPACK development. Wang (2020) partially structured the study around the concept that, for a CoP to be successful, it must incorporate three interdependent components: the design thinking process, proficient professional development, and the teachers' TPACK. The current study employed the concept of CoP as a contextual framework, and the constituents of proficient professional development as the organisational structure to

facilitate the conversion of TPACK into a further development of the teacher's knowledge and utilisation of technology. Kulavuz-Onal and Vásquez (2013) utilised the CoP and TPACK frameworks as specific means of analysing and interpreting data gathered from interviews, emails, and field notes. Through this approach, they were able to gain an understanding of how a particular community facilitated the process of teachers' acquisition of the knowledge and skills necessary for the effective integration of technology into their pedagogical practices. Similarly, Valsta et al. (2021) provided a comprehensive account of Laurea, a Finnish university of Applied Sciences, and its response to the exceptional circumstances presented by the COVID-19 pandemic in 2020. The study conducted by Valsta et al. (2021) focused on the supportive structures that constitute the formal work teams within the CoP framework. These structures encompass the IT department and academic coordinators, whose role is to provide support to teachers in the three TPACK knowledge domains. According to the findings of Valsta et al. (2021), team members tend to possess complementary skills and to maintain solid social connections in their CoPs.

Drawing from the literature, it can be posited that the CoP framework may be effectively applied to examine the contextual factors that shape the social networks of educators, given the fundamental role of this framework in shaping interpersonal relationships within professional contexts. One significant drawback of the CoP framework, as listed in Table 3.1, is that Wenger's (1998) explanation of the formation of social ties among individuals during the learning process lacks depth and specificity. It is noteworthy that Wenger's (1998) framework acknowledges the existence of individuals' ties, albeit with limited emphasis in comparison to later studies. It is possible that Wenger (1998) made the assumption, as any individual might, that individuals who participate in a CoP, whether formal or informal, will naturally form connections. In contrast to the Strong and Weak Ties Theory posited earlier by Granovetter (1973) conceptualisation of CoPs does not provide an explanation for the various forms of social ties that may arise among its members. The Strong and Weak Ties Theory posits that various forms of connections arise from the participation of the individuals in CoPs (Granovetter, 1973). Consequently, in order to enhance the CoP framework to achieve all the aims of this current study, Granovetter's (1973) Strong and Weak Ties Theory was employed to investigate the process of the formation of the CoPs under study, and the strengths of ties among the participating educators, as reported by them in the course of cultivating their TPACK in their hybrid CoPs during the COVID-19 pandemic.

Limited research has been conducted to investigate the development of interpersonal relationships among educators within the context of work. In two separate studies conducted by Adam (2017) and Spillane and Shirrell (2017) respectively, the presence of ties among school staff was found to be a prerequisite for the formation of social networks. Spillane and Shirrell (2017) further argue that social ties can serve as a means of enhancing reciprocity by accessing valuable resources such as information and advice. These ties can also facilitate the sharing of information, which in turn can lead to the development of knowledge. In their study on the cultivation of social ties among college faculty members in the US, Benbow and Lee (2019) found that the establishment of CoPs centred on teaching, and the accumulation of ties associated with social capital, necessitated significant investment from both faculty members and the organisation. Demir (2021) conducted a systematic literature review that focused on the various elements of social ties, namely bridging, bonding, linking, weak, and strong ties. According to Demir's (2021) implication, in order to maintain a dynamic and receptive approach towards change, it is necessary for teachers to have strong internal ties within their group, while also having weak external ties with teachers outside the group. Demir (2021) adds that educators who establish strong social ties with their immediate colleagues, such as those within the same team, subject, grade-level, or adjacent classrooms, should also cultivate and sustain ties with teachers from other CoPs, or even schools. This practice enables teachers to foster creativity, remain receptive to new ideas, and adapt to evolving circumstances. The literature review conducted by Demir (2021) presents a contrasting perspective to the study conducted by Granovetter (1977) nearly 46 years ago. Granovetter's (1977) research revealed that strong connections within networks may provide access to unneeded data due to the shared social context among CoP members. Granovetter (1977) further claimed that the presence of weak ties with individuals outside of the closely-knit network facilitates the acquisition of fresh information and knowledge that may be imperative for securing new employment opportunities or advancing one's career path. In line with, and prior to the survey conducted by Demir (2021), Fox and Wilson (2015) conducted a study on the social tie acquisition of novice teachers. Their study confirmed that novice teachers can enhance their chances of establishing strong relationships by engaging in certain practices, such as driving together to work instead of commuting alone, spending time in central staff areas in addition to local spaces and participating in after-school staff or student activities.

The extant literature suggests that Strong and Weak Ties Theory centres on the connections among individuals within and outside a given CoP. This elucidates the extent to which individuals may establish either strong or weak connections with each other during the process of acquiring TPACK in their CoPs. Conversely, a significant constraint of this framework pertains to its lack of elaboration regarding the mechanisms underlying the establishment of a context, such as that of a hybrid CoP, and the processes by which individuals acquire knowledge within it. Thus, I made use of CoP social learning theory as a primary framework for this current study and in order to close this gap.

3.6. Chapter summary

This chapter provided a justification for the utilisation of the three theoretical frameworks that directed the current study. The current chapter's literature review indicates that, regarding the social theory of learning, CoP has demonstrated its effectiveness as a framework for exploring and understanding the approaches that enable in-service teachers to establish hybrid CoPs, and in the process, improving their TPACK. In addition, this chapter demonstrates the applicability of the CoP social learning theory in the analysis of the four components of learning, namely community, practice, meaning, and identity. These components may serve either as cmotivating factors or as constraints in the development of primary school teachers' TPACK within hybrid CoPs. Furthermore, the literature suggests that the Strong and Weak Ties Theory can serve as an appropriate theoretical framework for understanding the dynamic process of the changes and strengths of relationships among in-service teachers in the course of their developing their TPACK within their hybrid CoP contexts during the COVID-19 pandemic. The forthcoming chapter will expound upon the methodology employed in the conducting of the research.

CHAPTER 4: RESEARCH METHODOLOGY AND DESIGN

4.1. Introduction

Chapter 1 provided a concise overview of the study design, methods, and methodology, along with the justification for selecting the research instruments. This chapter seeks to provide a thorough explanation of, and rationale for, the research design I used to address the main research question as presented in chapter one: *How and to what extent are current hybrid CoPs being used in a sample of primary schools to influence the development of in-service teachers' TPACK?* This question is further presented in Figure 4.1. This research aims to understand the influence of hybrid CoPs on the development of a sampled group of primary school in-service teachers' TPACK in a historically disadvantaged area of Khayelitsha in the Western Cape province of South Africa. The chapter provides a detailed overview of the procedure followed throughout the research project to plan, gather, and analyse the data necessary to answer the research questions. This overview elucidates and defends the philosophical (paradigm) stance taken as well as the research methodology used in this study. This design is examined in depth, along with its justification. In order to gain a thorough understanding of the topic under investigation, further information is provided about the sampling sites and participants, as well as the research methods and processes that were used in the data analysis. In addition to this, trustworthiness and ethical considerations are presented and explained in depth, together with the specific ways in which these factors contribute to the study's credibility and validity. The rest of this chapter is laid out as follows:

4.2 Research paradigm

4.3 Research Methodology

4.4 The research design

4.5 Site and participants

4.6 Data Collection

4.7 Data analysis

4.8 Trustworthiness

4.9. Researcher’s position and bias

4.10 Ethical considerations

4.11 Chapter Summary

4.2. Research paradigm

The present study was firmly situated within the interpretivist paradigm, as its main objective was to investigate and gain understanding of the experiences of in-service teachers in public primary schools as they participated in hybrid CoPs, with the inadvertent and/or deliberate aim of enriching their TPACK. According to Bertram and Christiansen (2020), a research paradigm can be defined as a distinct perspective that directs researchers towards the appropriate approach for conducting a study. In other words, a paradigm refers to a particular perspective or approach to studying phenomena. It encompasses a worldview, a set of accepted scientific knowledge and methods, a shared belief system or shared principles, and the identity of a research community. The significance of paradigms lies in its ability to establish the beliefs and principles that shape the research focus, methodology, and the interpretation of the findings for researchers within a given field (Kivunja & Kuyini, 2017). Other research paradigms, such as Positivism, Post-positivism, and Critical Theory exist. Researchers who use these paradigms make distinct assumptions regarding the nature of social reality. I considered that using any of the three would be neither relevant to, nor unsuitable for, the present study's aims. For instance, as asserted by Kivunja and Kuyini (2017), the Positivism paradigm relies mainly on deductive reasoning, the formulation and testing of theories, the provision of operational definitions, and mathematical equations, calculations, extrapolations, and expressions to reach conclusions. A post-positivism paradigm is characterised by a focus on empirical observation and scientific methods. Despite adhering to the scientific method and recognising the existence of an objective reality, the perception of knowledge is considered subjective rather than objective. This statement acknowledges the absence of an absolute truth, or at the very least, one that is attainable by the human mind. Instead, it posits the existence of knowledge that is only probabilistic in nature (Cohen, Manion, & Morrison, 2018: 15). From an epistemological standpoint, Critical Theory posits subjectivity as it contends that the researcher inevitably influences any object of research (Rehman & Alharthi, 2016). Dammak (2015) argues that Critical Theory researchers prioritise the interactive dynamic between researchers and participants, as well as the impact that social and historical factors can exert on them.

As advocated by Cohen, Manion and Morrison (2007), the primary objective of an interpretivist researcher is to learn about the way individuals interpret the world they inhabit and engage in their

routine tasks. Similarly. Bakkabulindi (2015) argues that interpretive research pertains to investigating individuals' thoughts, emotions, and communication patterns. The objective of the current study was to investigate and gather viewpoints from the participants concerning their past and potential encounters of the workplace environment. The utilisation of the Interpretivism research paradigm facilitated my immediate involvement with the multiple case study model. This model aimed to enable an investigation of the relationship between events and human connections that were associated with the study participants in a specific context. The selection of the Interpretivism paradigm for this study was justified by the intention to conduct a thorough examination of the participants' social experiences and perspectives. This involved employing various data collection techniques such as non-participant observation, open-ended questionnaires, and interviews, as advocated by Shah & Al-Bargi (2013).

The research used the methodology aimed at obtaining a deeper understanding of the viewpoints of the persons being studied and interpreting their views and the importance they attributed to their circumstances (Kivunja & Kuyini, 2017). According to Cohen et al. (2007), the Interpretivism paradigm requires understanding social phenomena from the perspective of the participants, rather than from that of the researcher. Stated differently, the observer attempts to understand the perspective of the person(s) or thing(s) under investigation, as opposed to the perspective of the observer. Social researchers employ methodologies such as consciously/deliberately attempting to understand, reveal and interpret meanings to gain insight into the social world from the perspective of its participants, rather than from that of an external observer. According to this point of view, social scientists, unlike natural scientists, understand that human behaviour is purposeful, that individuals see events through their own lenses and act on those perceptions, and that research must take this into account (Cohen et al., 2018: 20). Understanding the person and how they perceive the environment around them is of utmost importance.

Interpretivist perspectives posit that the development and the acquisition of knowledge are products of human construction, rather than objective realities (Lave & Wenger, 1991). This concept is not disputing the existence of the external world, but rather asserts that human cognition is influenced by our encounters, interpretations, and understanding. Rahi (2017) points out that the interpretivism perspective posits that genuine knowledge can only be acquired through a thorough interpretation of the subject matter. The interpretivism paradigm is commonly regarded as a

constructivist, naturalist, humanistic, qualitative, and anti-positivist paradigm, as noted by Shah and Al-Bargi (2013). The methodology employed for data analysis is inductive, which, in the course of its use, the researcher endeavours to identify patterns within the data that are then grouped under broad themes to enable as full an understanding as possible of a phenomenon and formulate a theory (Rehman & Alharthi, 2016). The Interpretivism paradigm has faced criticism for its perceived lack of rigorousness, limited potential for generating theories that can be applied to broader populations, and the potential for researcher bias due to their involvement with study participants (Grix, 2004). However, given that both case study research design and qualitative methodology are concerned with examining the detailed interpretations of participant experiences, an interpretivism paradigm aligns well with both approaches.

Moreover, the Interpretivism paradigm is consistent with the TPACK framework; the paradigm provides educators with an ideal combination of technological, pedagogical, and content knowledge. The Interpretivist paradigm facilitates the utilisation of theoretical frameworks such as the CoP social learning theory and Strong and Weak Ties Theory towards an understanding of the social processes that impact the context of teachers' TPACK development. When emphasising the coherence of the CoP social learning theory, and Strong and Weak Theory with Interpretivism, it is noteworthy that Interpretivists prioritise learning as a process that can take place unintentionally through individuals' workplace experiences. The utilisation of an Interpretivism paradigm, one which was based on abundant and contextual data, facilitated my understanding and representation of the perspectives, and lived experiences of a group of in-service teachers in public primary schools, with respect to the phenomenon being studied. The Interpretivism paradigm, commonly linked with qualitative research methodology, in the case of my study, assumes the possibility of diverse realities as perceived by the diverse members of a hybrid CoP (Shah & Al-Bargi, 2013).

4.3. Research methodology

The aim of the current research is to assess the influence of hybrid CoPs on the professional growth of a group of participant in-service teachers in specific public primary schools, with a focus on the enhancement of these teachers' knowledge concerning technology-integrated teaching and learning. To achieve this aim, for my study I employed a qualitative research methodology. I employed non-quantitative methods for data collection and analysis to clarify social connections

and show the actuality/actualities encountered by the participant in-service teachers who belonged to hybrid CoPs. This methodology primarily focuses on the mental and emotional processes of individuals, as well as on the interpretations they derive from their behaviours. Okeke (2015) contends that qualitative researchers have the potential to accurately represent the real-life perspectives of their research participants as they strive to fully understand the meanings associated with their research. This was observed in the current research.

Askarzai and Unhelkar (2017) argue that qualitative research comprises the systematic collection and scrutiny of textual data with the purpose of gaining an understanding of the interpretations and perspectives of individuals regarding a phenomenon, the kind of understanding that cannot be adequately explored through quantitative research methods (see Table 4.1 below). The methodology in question, as shown in Table 4.1, challenges the positivist paradigm and seeks to incorporate diverse perspectives by analysing a select few cases in detail, as noted by scholars such as Creswell (2012), Creswell and Creswell (2017), and Zina (2021). Kothari (2004) posits that qualitative research holds particular significance in the behavioural sciences, as it facilitates the exploration of the fundamental drivers of human behaviour. Thus, Creswell and Creswell (2017) point out that the qualitative research process entails formulating questions and approaches, gathering data in the participant's natural setting, inductively analysing the data by moving from specific instances to general themes, and the researcher making evaluations regarding the data's importance. Similarly, Saldana (2013) posits that the initiation of qualitative research involves the development of an epistemological research question that allows the researcher to enhance his/her understanding of a phenomenon (e.g., the concept of parenthood) or an ontological research question that captures the specific reality of the participant (e.g., the lived experience of adults with depression). During the investigation process, the researcher gathers information from various sources and activities to derive a deep understanding of the world through the analysis of data texts (Coy, 2019).

Qualitative methodologies are characterised by their naturalistic and emergent nature, whereby the data collected is utilised to uncover the pertinent information in the investigation (Coy, 2019). The process of data collection is notably more transparent than would be the case using a quantitative method and aims to achieve an in-depth understanding that can only be attained by imitating the instance under investigation. As emphasised by Flick (2020: 39), it is mandatory for the

participants to provide spontaneous responses in their own language to the questions posed. According to Askarzai and Unhelkar's (2017) summary, the qualitative methodology possesses various strengths, which are listed below. Some of these are shown in Table 4.1:

- The method offers complex textual descriptions of individuals' encounters with a particular phenomenon.
- It can be employed for researching fragile subject matter and culturally constructed experiences.
- The acquisition of knowledge through the examination of a phenomenon can yield significant insights.
- This approach facilitates an in-depth understanding of complex phenomena, rendering it advantageous for exploring individual instances.
- It offers valuable insights into the behaviour, perception, and experiences of individuals.
- Typically, qualitative research data is characterised by its comparatively small sample size, convenience of collection, and cost-effectiveness.

According to Askarzai and Unhelkar (2017) as well as to Flick (2020), it has been argued that one limitation of qualitative research is the time-consuming nature of conducting precise and accurate analyses. Additionally, it has been suggested that only a restricted amount of data can be predicted or generalised to the broader population (Hammersley, 2007; Haq, 2015). Moreover, as per Hammersley's (2007) assertion, the generalisation of qualitative findings is problematic and challenging due to the absence of statistical analysis (see Table 4.1). The existing literature indicates that the primary focus of qualitative researchers is not the generalisation of their findings, but rather for them to employ their findings in making assumptions and drawing comparisons. It should be mentioned that researchers may employ other available methodologies, such as quantitative or mixed methodology, respectively. Table 4.1 below shows a comparison of qualitative methodology with other methodologies, as described by Haq (2015: 4).

Issue	Qualitative	Quantitative	Mixed
1. Main objective	Understanding and elucidation of social phenomena	Generalisation and validation	Aims encompass both elucidation and generalisation
2. Size	Minimal	Extensive	Varied
3. Data quantity	Substantial textual raw data	Relatively modest numerical data	Incorporates both substantial and modest data quantitie
4. Connection with respondents	Strong one-on-one connection	Minimal direct interaction	Establishes strong one-on-one connections with select participants
5. Commonly employed data gathering methods	Semi-structured interviews, user-friendly yet resource-intensive	Large-scale surveys, featuring low response rates but cost and time-efficient	Integrates methods based on objectives, but is more resource-intensive than either qualitative or quantitative approaches
6. Frequently utilised data analysis methods	Thematic content analysis, laborious and time-consuming	Statistical analysis with computer-aided software, comparatively straightforward and swift	Combines techniques from both qualitative and quantitative methodologies, resulting in lengthier processes and higher costs

7. Adaptability and standardisation	Flexible	Less adaptable than qualitative analysis	More adaptable than either approach
8. The research method and data quality	Meticulous documentation enhances the quality of process and data	Sacrifices data quality for standardisation	Regarded to have superior quality of both process and data compared to other methods
9. Interpretation of findings	Considerable interpretation is necessary	Interpretation is succinct owing to statistical use	Interpretation is more challenging and time-consuming due to the utilisation of both qualitative and quantitative methods
10. Applicability to broader contexts	Typically, generalisability is not sought	Generally high generalisability	Generalisability is more robust than in either of the other two methods
11. Triangulation of data	Generally, triangulation is not practiced	Generally, triangulation is not employed	Triangulation is implemented
12. Overall utility, disregarding constraints such as cost,	More beneficial than quantitative approaches for grasping social phenomena	More beneficial than qualitative methodologies for replication	Generally more beneficial than either qualitative or quantitative

time, and expertise			methodologies in all respects
13. Terminology used to describe the quality of research	trustworthiness	rigour	Emphasises both trustworthiness and rigour

Tabe 4.1: Comparison of qualitative, quantitative and mixed methodologies (Haq, 2015: 4).

As defined by Alok and Mishra (2017) and as can be seen in Table 4.1 above, quantitative research is concerned with the quantity and/or range of data. This kind of analysis is based on the quantification or measuring of quantity. It is relevant to occurrences that are able to be measured and that are linked to things or instances that can be counted or quantified (Kothari, 2004). In general, quantitative research is broad in scope but shallow in depth (Zina, 2021). Quantitative research is sometimes characterised as objective positivist study into the one and only truth based on hypotheses, variables, and statistics. By measuring human behaviour statistically, it generalises results but does not go into depth on the reasons for, or the effects of, that behaviour (Ryan, 2018). Thus, it is linked to positivist paradigms that focus on testing hypotheses and tend to provide quantitative data (Tuli, 2010). As shown in Table 4.1, the ability to generalise results to a broad population due to the data's huge random sample size is one of the quantitative methodology's strengths, and research results that are based on precise and quantitative data are often accurate and dependable (Askarzai & Unhelkar, 2017). Askarzai and Unhelkar (2017) additionally highlight the limitations of quantitative methodology. These may include the possibility that a quantitative study on human phenomenon elements like motivation and perception might yield restricted findings and this kind of study need more time to analyse the collected data, given the big sample size.

As Table 4.1 shows, in an attempt to address the limitations and complexities associated with quantitative and qualitative research methodology, some researchers elect to integrate these methodologies, resulting in what is commonly known as mixed methodology. The mixed

methodology research approach is a method of investigation that encompasses the gathering of both quantitative and qualitative data, their combination, and the utilisation of various designs that may incorporate philosophical assumptions and theoretical frameworks (Creswell & Creswell, 2017: 29). The fundamental principle underlying this approach to any investigation is that the integration of qualitative and quantitative data provides additional insights that surpass the individual contributions of each type of data (Creswell & Cresswell, 2017; Zina, 2021). To clarify, utilising a mixed methodology offers a multitude of vantage points from which to examine a particular subject. Employing a mixed methodology facilitates an in-depth investigation of statistical trends as well as activities not only to present them but also to clarify them, thereby providing a comprehensive perspective on phenomena, see Table 4.1.

This current research did not use mixed or quantitative methodologies for several reasons. The nature of this current study suggests that, to try to respond to the current research's question, a variety of aspects would need to be considered. There are too many factors at play in teachers' TPACK development for them to be precisely measured or singled out to establish whether one causes the other. The rationale behind employing a qualitative research methodology for this study lies in the recognition that a straightforward equation is unlikely to effectively illustrate or elucidate the intricate, conflicting, interdependent, and evolving relationships among technological, pedagogical, and content requirements, and how these interactions are influenced by the social environments that mold teachers' practices. Additionally, the interpretivism paradigm, which places priority on understanding people's perceptions and experiences of the world in which they live and go about their everyday activities, is compatible with the qualitative methodology used in this research. Through engaging with the ideas and perceptions of participants, I was able to acquire a thorough grasp of the meanings and identities that these participants created because of their engagement in hybrid CoPs.

4.4 Research design

Given that the current research is interpretive in nature and aims to undertake an in-depth exploration of the influence of hybrid CoPs on the enhancement of TPACK among selected in-service teachers in three ($n=3$) public primary schools, a multiple case study research design was employed. As per Creswell's (2013: 97) assertion, case study research is a qualitative methodology that involves the examination of a confined system (a case) or several restricted systems (cases)

over a period of time. This is achieved through comprehensive and meticulous data collection from various sources (such as observations, interviews, audiovisual materials, and documents and reports), with the aim of generating an in-depth description of the case and identifying themes that are grounded in the case. Compton-Lilly (2012) has observed that case studies can vary in terms of their size, methodology, scope, duration, geographical coverage, epistemological foundations, and intended objectives.

I adopted a multiple-case study research design for several reasons. The multiple case study research design allows for the inclusion of more than one case within the same investigation (Fraenkel et al., 2012). In the realm of education, a researcher may opt to investigate different cases, such as the introduction of a novel curriculum resulting in changes to class schedules or the integration of innovative educational technologies in multiple schools (Yin, 2003: 46). Thus Achari (2014) argues that the selection of a multiple case study design is deemed suitable for the purpose of retaining the in-depth attributes of actual incidents while studying factual occurrences. Miles, Huberman, and Saldaña (2014) argue that a study's interpretation increasingly convincing with an increase in the number of cases and the extent of variation among them. Through examining a variety of similar and distinct cases, it is possible to gain insight into an individual case discovery by clarifying the manner and the location in which it persists, and, if feasible, the reasons behind its persistence. Incorporating numerous cases is a technique widely used to strengthen the external validity or generalisability of one's findings. Case studies are research designs frequently utilised by interpretivist researchers, as noted by Bertram and Christiansen (2020). Thomas (2011) highlighted the similarity of a case study research design and the interpretivism paradigm, suggesting that they are well-suited to each other. Cohen et al. (2007) provided confirmation of the connection between the case study and interpretative paradigm, highlighting their natural complementarity and mutual reinforcement.

It is generally acknowledged amongst qualitative researchers that employing a multiple-case study design presents both advantages and disadvantages, unlike a single-case study. According to Fraenkel et al. (2012), the utilisation of multiple-case studies is frequently perceived by researchers as more persuasive and rational when it comes to determining generalisations from their outcomes. However, one of the disadvantages of conducting multiple-case studies is that several case studies conducted simultaneously typically requires a significant allocation of financial and temporal

resources (Fraenkel et al., 2012; Fraenkel et al., 2019). In order to mitigate such constraints, I allocated ample time to the acquisition of data to ensure, to the best of my ability, that all instances were comprehensively investigated. Furthermore, I employed the "replication logic", as defined by Yin (2012). The research design employed by a researcher when anticipating identical outcomes for each of the cases being examined, while providing evidence of their comparability, is referred to as the replication logic. The present study showcases how teachers at the three schools involved in the study unintentionally and intentionally established and employed hybrid CoPs to both acquire and enhance their TPACK. The utilisation of a case study design was deemed as the most suitable approach for the current study due to its emphasis on quality over quantity, and its prevalence as one of the most employed qualitative designs (Lodico, Spaulding & Voegtle, 2006). Furthermore, through the utilisation of an interpretivism paradigm and a research design that revolved around case studies, I aimed to attain a deeper understanding of the process involved in addressing the research questions which gave rise to the current study.

4.5 Research Sample

Initially, the present study employed convenience sampling as a method of data collection that involves selecting individuals from a population that is readily available and easily accessible to the researcher (Rahi, 2017). In research, the term "sampling" typically encompasses two key actions (Emmel, 2013). The first involves identifying a population from which a sample will be selected, with the aim of ensuring that the sample is representative of this population (Emmel, 2013). The second action involves guaranteeing that every individual or entity within this predetermined population has a measurable chance of being included in the sample, with a probability greater than zero (Emmel, 2013). In order to find willing participants, I personally hand delivered the survey questionnaires to the three ($n=3$) public primary schools, handing out copies to the entire population of 89 in-service teachers across the three ($n=3$) schools. However, only 27 teachers completed and returned the copies when I went back to collect them the following days. Further elaboration on the use of survey questionnaires is provided in section 4.6.1. To address the credibility concerns related to convenience sampling, I employed purposive sampling as an additional method. Purposive sampling is a non-probability technique where study participants are intentionally selected from a population according to specific criteria predetermined to align with the research objectives (Kumar, 2011). The process of case selection

in research involves the identification of cases that are rich in information and are likely to be most suitable for providing valuable insights in response to the research questions. The ultimate goal of this process is to persuade the research audience of the validity and significance of the research findings (Emmel, 2013). I made use of this sampling technique to identify the most suitable in-service primary school teachers in the group of 27 who returned the survey questionnaires and who indicated in their response that they frequently obtained assistance from other colleagues when it comes to the use of technology in their practice. In this instance, I selected 12 from the pool of 27 in-service teachers whose responses were most pertinent either to occasionally providing assistance or receiving assistance from colleagues concerning the integration of technology into their teaching practices. I considered the 12 participants to be sufficient for this current study as they all met the criteria (further elaboration on the participants is provided in section 4.5.2). In line with the limited sample size, Creswell (2013) observed that, given the nature of the case study method, it is feasible to attain diverse perspectives on the studied phenomenon even with a small participant group. He termed this sampling approach, 'purposeful maximal variation'.

4.5.1. Selection of research site

The current study was carried out in three (*n=3*) public primary schools purposively chosen from the MEED located in the Western Cape region. The schools are located within the jurisdiction of the City of Cape Town municipality. To maintain confidentiality, the schools in question have been anonymised and are from this point on referred to as School A, School B, and School C. The trio of schools, comprising a sample size of three (*n=3*), are geographically located within a 4-kilometre radius in the region of Khayelitsha, a community that has been historically marginalised. I purposefully chose the schools as they recently commenced integrating certain new technologies into their teaching, facilitated by the WCG. School A and School B benefited with educational technology from all four (*n=4*) TPD programmes involved in this current study, which include the Khanya Project, WCG Game Changer project, Clicks Foundation, and Green Shoots programme. School C benefited from technological resources from the three (*n=3*) TPD programmes, with the exception of the Clicks Foundation. I resided near the participating schools hence I chose them as I anticipated it would be advantageous in terms of saving time and money on travel. This measure ensured that I had sufficient time with the participants to conduct the in-depth research required within the qualitative methodology. Also, I was familiar with the study locations, and this made it

convenient and easy to approach participants in their natural environment. The present study includes three (*n=3*) schools that are classified as quintile three schools. In South Africa, schools are categorised into quintiles one to three based on their location in the most poor geographical areas. This classification is done by the government to identify schools that are economically disadvantaged. (Nudelman, Moodley & Berman, 2018; Ogbonnaya & Awuah, 2019). Quintile four and five schools, situated in more affluent urban and geographical areas, are considered economically advantaged (Nudelman et al., 2018; Ogbonnaya & Awuah, 2019). Ogbonnaya and Awuah (2019) further note that quintile one to three schools are designated as non-fee-paying schools and receive higher government funding compared to quintiles four and five. The latter are classified as fee-paying schools and receive minimal or no government funding, except for the remuneration of their teaching staff, which is determined by a standard teacher-learner/class size ratio.

In comparison with other historically underprivileged schools in Khayelitsha, the three (*n=3*) schools had a strong technological infrastructure. Therefore, these schools could be considered to have advanced technologies in terms of quality and quantity, making it easier for me to answer the research question: *How and to what extent are current hybrid CoPs being used in a sample of primary schools to influence the development of in-service teachers' TPACK?* Considering the research question and the chosen methodology and design, I found it necessary and suitable to utilise purposive sampling for selecting schools. This approach aimed to engage individuals who possessed relevant expertise in TPACK development through their involvement in hybrid CoPs. It's important to recognise that this sample wasn't intended to represent the entire research population. Purposive sampling was chosen for its simplicity, cost-effectiveness, and time efficiency. While the findings are not meant to be generalised to the broader population, they can still offer insights applicable to similar contexts, albeit with certain limitations.

It should be noted that at the time of the study, I was a full-time teacher at one of the primary schools where the data was collected. Therefore, to reduce possible bias, I was aware, and careful not to guide participants in specific or pre-determined directions during data collection. I was aware that participants must be allowed to talk freely and that all answers should be recorded verbatim. I acted as a facilitator and made a concerted effort to refrain from influencing participants in any manner. I strictly interpreted data as provided by participants and ensured that the affiliation

of the school did not impact how the data was perceived or interpreted by me. To the best of my conscious awareness, I prevented my sentiments regarding the school from influencing me or steering participants to respond in a particular manner to questions. Put simply, participants were at liberty to respond to questions as they deemed fit, or based on their own perspectives, without any intervention from me as the researcher. I made every effort to uphold neutrality in this regard, mainly through a structured data collection process.

4.5.2 Selection of participants

School A had thirty-one (*n=31*) teachers, School B had twenty-nine (*n=29*) teachers, and School C had thirty-nine (*n=39*) teachers. As already mentioned, the aim was to purposively choose the most appropriate participants from the entire population based on their survey questionnaire responses on whether they were at the time of the study collaborating with other teachers concerning the utilisation of technologies for curriculum delivery. At School A, nine (*n=9*) in-service teachers completed and returned survey questionnaires, and eight (*n=8*) in-service teachers at School B also completed and returned their questionnaires, and at School C ten (*n=10*) in-service teachers returned the questionnaires. Nonetheless, to answer the research question, four (*n=4*) teachers at each school were selected. Therefore, 12 out of 27 teachers were included in the study as they had affirmed, through the survey questionnaires, that they were collaborating as a cohesive unit within their individual schools regarding the use of technology for teaching and learning, thereby providing evidence of the presence of CoPs at their respective schools. During this process of purposively choosing possible participants, I was mindful of the priority that each grade, between grades 3–6, must be presented in the sample as this was and is the priority of all four (*n=4*) ICT initiatives of the WCG. Thus, one (*n=1*) Foundation Phase teacher, and three (*n=3*) Intermediate Phase teachers per school were selected. To sum up, according to the sub-groups within the sample, there were a total of nine (*n=9*) teachers from the Intermediate Phase, and three (*n=3*) teachers from the Foundation Phase.

The reason for the selection of a higher number of participants from the Intermediate Phase compared to the lower number of Foundation Phase participants is because the Click Foundation initiative does not include Foundation Phase teachers in its target group, which may explain why there were more participants from the Intermediate Phase than from the Foundation Phase. In addition, the Green Shoots initiative places its emphasis on the Intermediate Phase (Grade 4–6)

and the Senior Phase (Grade 7), with only the grade 3 in the Foundation Phase gaining support, as mentioned earlier in Chapter 2. However, two of the WCG initiatives (Khanya Project and the e-Learning Game Changer) concentrated equally on teachers and/or learners from all phases at a primary school level (Foundation, Intermediate and Senior). Also, I intended to include teachers in the Foundation Phase in the research, since they were at the time of study also part of hybrid CoPs in their schools, and the principals of all three (*n=3*) schools confirmed before data collection that these teachers had access to technological resources. Thus, in line with the objective of this current research, the aim was not to search for representativeness, but to acquire the kind of deep, concentrated knowledge that may be gleaned by the researcher from a small number of participants rather than from many (Zina, 2014).

One (*n=1*) principal from School C, and two (*n=2*) deputy principals from Schools A and B respectively, were purposively chosen to make up the sample of the study. Since teachers are directly affected by the lack of TPDs on technology use, I considered it essential to include a greater number of teachers in this study relative to the number of school managers (principals and/or deputies). The study involved principals and/or deputy principals because of their leadership and supportive functions in facilitating teachers' access to and utilisation of available technologies, especially for enhancing teaching and learning. Additionally, these principals and/or deputy principals had previously indicated that they occasionally share information about teaching material with their teaching staff. This approach aligns with Geertz (1973: 245), who advised against sub-groups in a sample being excessively small to avoid data redundancy or saturation. It's also suggested that each sub-group should include at least three cases. However, in contrast to this view, Marshall and Rossman (2016: 108) contend that there are no fixed rules regarding sample size in qualitative research; instead, size should be determined by its suitability for the intended purpose, hence the sample size can range from one to many.

The sample consisted of in-service teachers who teach Mathematics and languages as subjects in the Intermediate Phase, as well as teachers in the Foundation Phase whose curriculum also includes Mathematics and languages. The reason for using these criteria is that the present focus of technological resource initiatives in the Western Cape is on these disciplines. Table 4.2 summarises the rest of the participants' profiles:

School	Teachers	Age	Gender	Phase	Grade	Subjects	Teaching experience in years
A	A	44	Female	Foundation	3	Isixhosa, Mathematics, English	17
	B	39	Female	Intermediate	4	Isixhosa	14
	C	31	Female	Intermediate	5	English	1
	D	29	Female	intermediate	6	Isixhosa	1
B	E	26	Male	Intermediate	6	Mathematics	3
	F	54	Female	Foundation	3	Isixhosa, Mathematics, English	26
	G	36	Female	Intermediate	5	English	12
	H	26	Female	Intermediate	4	English	1

C	I	41	Male	Intermediate	6	English	8
	J	40	Male	Intermediate	4	Mathematics	12
	K	29	Female	Foundation	3	Isixhosa, Mathematicss, English	1
	L	29	Male	Intermediate	5	Maths	3
Principal/deputy	A	35	Male	-	-	-	12
	B	49	Male	-	-	-	22
	C	60	Female	-	-	-	33

Table 4.2: Participant educators' profile

Table 4.2 above demonstrates that all 12 teachers were teaching subjects encompassing IsiXhosa Home Language (HL), English First Additional Language (FAL), and Mathematics. These subjects are identified as focal points within initiatives such as the Khanya Project, Green Shoots Project, Click Foundation, and the WCG's e-Learning Game Changer project. Teachers in the Foundation Phase were each responsible for teaching all three (*n=3*) subjects as part of the Foundation Phase curriculum: Home Language (IsiXhosa), First Additional Language (English), and Mathematics. While Guthrie (2010) argues for the benefits of larger sample sizes, correlating them with enhanced results and trustworthiness, I opted for a small-scale study to capitalise on time and cost savings. Conducting a large-scale study can be financially and temporally burdensome (Cohen et al., 2007). I considered the selected number of participants to be enough for exploring the research

phenomenon and answering the research question. I prioritised careful budgeting, recognising that a larger sample would demand more resources and incur greater expenses, which were not feasible during the data collection phase. Time constraints were also significant, making it impractical to dedicate extensive time to convincing teachers to participate initially. Preparatory meetings were necessary to elucidate the research study's purpose and garner participants' willingness to engage. Furthermore, it's essential to note that learners were not included in the sample, as the focus of the phenomenon and cases revolved entirely around educators (teachers and principals). Hence, I found it suitable to tackle the research question by engaging and gaining insights from primary sources, namely educators.

4.6. Research methods

The current study employed several different qualitative data collecting methods for triangulation purposes, such as open-ended survey questionnaires, one-on-one interviews, non-participant observations, and document analysis in order to examine and understand the specific ways in which hybrid CoPs aid in-service teachers in developing the kind of knowledge considered essential for teaching using technology. The decision to incorporate these data collection tools is consistent with Sullivan (2012) who claims that there are many ways to collect qualitative data, whether it is by interviewing individuals, holding a focus group, observing as a participant or non-participant for observations, content analysis, or a combination of various methods. Madondo (2021) adds that quantitative studies include open ended survey questions, semi-structured interviews, and/or other forms of qualitative data. Qualitative research methods allow researchers to understand the experiences of participants in depth; they allow for exploration of the ways decisions are made and provide us with a detailed insight into how interventions may alter care (Barrett & Twycross, 2018). To generate such insights, qualitative research necessitates comprehensive, detailed, and nuanced data, facilitating the emergence of themes and findings through meticulous analysis. This section thoroughly examines the methods employed for data collection in the present study and offers justifications for their utilisation. Each of these research methods is individually scrutinised in the subsequent sections.

4.6.1. Self-administered paper-based survey questionnaires

I used open ended survey questionnaires in the current study to collect information from the whole population of 89 in-service primary school teachers (Simmons, 2008). As emphasised by Ponto (2015), and for the purpose of this current study, survey questionnaires have the possible advantage of providing the researcher with a choice of approaches for participant recruitment, data collection, and instrumentation. For this reason, open ended survey questionnaires (Appendix A) were specifically used as one of the qualitative data collection instruments (Ponto, 2015) in the current study. As recommended by Jotforms Surveys (2022), this is the kind of short survey that utilise a questionnaire with a limited number of questions, and it is used largely for the express goal of identifying and recruiting willing and suitable participants for the sample. However, it must be noted that the data collected through survey questionnaires of the 12 participant teachers in this current study were also analysed since the study is qualitative in nature. Thus, only two open-ended questions rather than closed or multiple-choice questions were used. Cohen et al. (2018) highlight that the open-ended questionnaire is a favourable tool for smaller-scale research or for certain portions of a questionnaire that want genuine, personal feedback from respondents, in addition to numerical ratings and checkboxes. It is most closely associated with the survey to the point that many people call the instrument a 'survey', rather than a 'questionnaire' (Williamson, 2002: 235), hence it is referred to as “survey questionnaire” for the purpose of this current study. It is principally used to collect quantitative data, but open-ended questions can be used to elicit responses for qualitative data. Rahi (2017) agrees that the survey strategy may be popular in social sciences and associated with a deductive research approach in which information is collected via interviews or a pre-designed questionnaire. In this instance, the questionnaire presents open-ended questions and provides a designated space (or delineates lines) for participants to offer free responses (Cohen et al., 2018).

Participants may choose between paper-based survey questionnaires that are physically sent or distributed to them, electronic survey questionnaires sent to them by email, or via an Internet-based application, such as Survey Monkey, or a mix of both (Ponto, Ellington, Mellon & Beck, 2010). The current study employed a self-administered paper-based survey questionnaire, which was distributed directly to the participants. According to Neuman (2014), a common method for collecting data involves researchers distributing survey questionnaires to respondents either in

person or via mail, and subsequently documenting their responses. Survey questionnaires of this nature are commonly utilised as a cost-effective and expeditious means of attaining a substantial sample size (Cox, 2020). In this study, the decision was made to distribute the questionnaires in person to the prospective respondents, rather than utilising electronic mail. The rationale behind my decision was rooted in my knowledge of the drawbacks associated with disseminating questionnaires via mail or email. This method often results in a significant proportion of individuals demonstrating non-compliance by failing to complete and return such questionnaires. Hence, to mitigate such challenges, I opted to personally deliver the instruments to the possible participants at each of the three (*n=3*) schools and collected them from the participants on the following day. I took into consideration the possibility exists that respondents might not take the activity seriously, and that the researcher may not be able to determine whether this is the case, as described by Robson (2011). To avoid this happening, I made it clear in the survey questionnaires that respondents are strongly encouraged to provide answers that are as truthful as it is possible for them to be.

It is worth noting that self-administered survey questionnaires tend to elicit lower response rates compared to interviews in the absence of a researcher, as per Cox's (2020) assertion. In order to enhance the response rate, it is imperative that self-administered survey questionnaires are formulated in a manner that is understandable and clear, given the absence of an interviewer to address queries or offer clarification (Cox, 2020). In order to mitigate the potential challenge in this current study, a set of survey questionnaires was devised, comprising solely of two uncomplicated open-ended questions (Appendix A). It is of importance to reiterate that, for purposes of this current research, open-ended survey questionnaires were utilised as an initial sampling technique and data collection method as the least time-consuming method for recruiting 12 potential teacher participants from the entire population of ninety-eight (*n=98*) public primary school in-service teachers in the three (*n=3*) primary schools. Cohen and Manion (1994: 86) stress the need for drawing an appropriate or useful sample from the population to be examined, rather than attempting to contact every single person in an entire population. Creswell (2007) strongly emphasised the importance of choosing suitable participants for in-depth interviews in terms of the research topic being discussed. Consequently, the survey questionnaire for the current study was designed to gather data that would provide me with proof of the presence of hybrid CoPs

among teachers, groups whose aim was the enhancement of group members' TPACK in the involved schools.

The initial section of the survey questionnaire comprised of an information sheet that contained pertinent details about the research study, the researcher's contact information, participants' personal information, and their privacy declaration. The participants were provided with a guarantee that the information being requested would be utilised solely for the purposes of the current study. The act of placing their signature to the consent form served as an indication of their agreement and acceptance. The participants were duly notified of their option to discontinue their participation in the survey questionnaire at any stage. Additionally, they were informed of the determination of their submissions once made. The participants were provided with the opportunity to revise or remove their responses after the submission of the survey questionnaires. They were requested to disclose their willingness to partake in the main research effort, with their identities remaining undisclosed. The request was mandatory in nature. The survey questionnaire was comprised of two (*n=2*) open-ended questions that were designed in accordance with the conceptual framework of the research investigation. The survey questionnaire proved advantageous due to its user-friendly administration, which enabled the targeted in-service teachers to easily access it. Additionally, it facilitated an analysis of responses, thereby enabling me to make informed decisions in a convenient manner.

Prior to administering the survey questionnaires to the teachers, a pilot test was conducted on March 14th, 2023. I requested two teachers who were not included in the sample from School C to respond to the survey questionnaires. Upon finishing the survey questionnaire, participants were provided with a blank sheet of paper to address and evaluate the questions proposed by Fraenkel et al. (2012: 401):

- Inadequately formulated questions;
- Questions that may be misinterpreted;
- Ambiguous selection of options;
- Clarity of instructions;
- Alignment of survey language with the reading skills and native language of the population;

- Visual attractiveness of the questions; and
- Appropriateness of the categories.

Through the implementation of the piloting a survey questionnaire, I was able to effectively address the concerns which arose in the following ways:

- The number of questions was reduced from five to two after pilot participants indicated that there appeared to be repetition;
- The questions were rephrased to provide more clarity and easy access; and
- The inclusion of sections necessitating the provision of participants' contact information was added.

4.6.2. One-on-one semi-structured interviews

Informed by the insights gleaned from the survey questionnaire, I crafted a semi-structured interview guide (Appendix B) as the primary data collection method for engaging with teachers. Individual semi-structured interviews were conducted once with each of the 12 teachers whose survey questionnaire responses were deemed most pertinent to the research topic. These interviews featured open-ended questions, providing respondents with the flexibility to share their perspectives and experiences. This approach allowed for a deeper exploration of the topic beyond the confines of the interview schedule. In this context, Cohen, Manion & Morrison (2005: 146, 248) indicate that semi-structured interviews are commonly employed in qualitative research. These interviews involve crafting a schedule that is "sufficiently open-ended," enabling participants to delve into "digressions and expansions" while allowing for "further probing." Semi-structured interviews were conducted to acquire a better and deep understanding of the nature and extent of the influence of hybrid CoPs on the development of the selected public primary school in-service teachers' TPACK. I had questions prepared in advance, and during the interviews I engendered a more complete picture by following up on any intriguing pathways that tended to arise in an interview (Smith, 1995: 16). I made use of Robson's interview schedule guidance (2011) to organise questions and notes. To clarify, I used a predetermined list of questions for the interview, but I did not confine myself just to those questions or adhere strictly to their wording throughout each interview. Semi-structured interviews offered the possibility of engaging and addressing topics in depth with the participants (Smith, 1995). This technique was utilised to

gain a detailed and comprehensive presentation of each participant's experience and perspective concerning the phenomenon. The semi-structured interview schedule included a series of unstructured and open-ended questions formulated to stimulate more profound discourse about an issue. I was also aware of several drawbacks associated with conducting interviews, despite the fact that they have the potential to be useful to as a data collection tool. According to Robson (2011), the majority of interviewers tend to speak too much and have a tendency to use interviews as a platform to convey their own personal experiences and viewpoints. In order to prevent or limit this, and to ensure the value and trustworthiness of the research, I was prepared to say less, and to be intentionally aware of saying less, and to listen more.

Participants were furnished with a comprehensive information sheet, a consent form (see Appendix E), and the interview schedule. The interviews with the 12 sample teachers were conducted in their respective classrooms after regular school hours, typically lasting between 7 to 20 minutes per session. The interviews were originally intended to last a minimum of 30 minutes, but due to the educators' short responses and limited interaction with me as the interviewer, the longest one ended up lasting only 20 minutes. By scheduling the interviews after school hours, it was assured that no learners were present on the school grounds, so minimising any disturbances to the teaching and learning activities that take place during school hours. Similarly, in order to avoid disrupting their responsibilities during the school day, interviews were held in the offices of one principal ($n=1$) at School C and two deputy principals ($n=2$) at School A and B after school hours. The interviews with the principal and deputy principals lasted roughly 7–10 minutes each and semi-structured interview schedules (Appendix C) were also used. I meticulously noted non-verbal cues, such as body language, throughout each interview to apply them in interpreting the data. All interviews were conducted in either English and/or Isixhosa as participants were given the opportunity to respond in any of the two languages. Thus, I sent the audio recordings to a professional translator. The interview questions were guided by the three ($n=3$) frameworks underpinning this study (CoP social learning theory, Strong and Weak Tie Theory, and the TPACK model). Before commencing the interviews, consent was obtained from the educator participants to audio-record the sessions. An audio recorder was utilised to ensure accurate capture of the interviews, while an interview schedule/protocol was employed to record supplementary notes. Subsequently, the audio-recorded interviews were transcribed verbatim for subsequent analysis. The rationale behind using audio recorders was to procure detailed and precise records of each interview. Recognising the possibility

that some participants might feel uneasy about being voice recorded due to concerns about potential repercussions (Creswell & Guetterman, 2019), I prepared to address this apprehension. Accordingly, the interview schedule was structured to allow for notetaking as an alternative if any participant objected to audio recording. Importantly, all interview questions were crafted in alignment with the theoretical frameworks guiding this study.

The main aim of conducting research interviews was to explore individuals' viewpoints, experiences, beliefs, and/or motivations regarding the research phenomenon. According to Gill, Stewart, Treasure, and Chadwick (2008), interviews and other qualitative methods are believed to provide a more profound comprehension of social phenomena compared to relying solely on quantitative methods, such as questionnaires. Conducting interviews with participants is a prevalent feature of numerous qualitative research studies. Barrett and Twycross (2018) argue that interviews offer a highly effective and clear method for obtaining extensive and substantial information on a specific phenomenon. Thus, interviews are well-suited for investigating sensitive topics, as they provide a comfortable setting for participants who may be hesitant to discuss such matters in a group setting (Gill et al., 2008). Interviews are the predominant form of data collection in qualitative research. They are a well-known and adaptable approach to gathering individuals' perspectives and experiences. Apart from semi-structured interviews, Gill et al. (2008) elucidate that there are two additional primary types of research interviews: structured and unstructured interviews. Nonetheless, for the aim of this present study, semi-structured interviews were considered appropriate.

A common qualitative research method is the semi-structured interview, where the interviewer explicitly addresses core aspects of the phenomenon under investigation (Barrett & Twycross, 2018). Semi-structured interviews were considered appropriate for this study as they blend elements of fixed-choice responses with the opportunity to delve deeper into specific areas of interest (Brewerton & Milward, 2001). This approach offers the advantages of both structured and unstructured interviews, enabling ease of analysis, quantification, and comparison while allowing respondents to elaborate on their responses and provide detailed information as needed. However, it also presents challenges such as the risk of digressing into peripheral topics, potential loss of control to the interviewee, and reduced reliability when using non-standardised interview approaches (Brewerton & Milward, 2001). Compared to structured interviews, the flexibility of

semi-structured interviews enables respondents to elaborate on information that may be important to most participants but was not initially considered relevant by the research team (Gill et al., 2008). Additionally, according to Brown (2001), in semi-structured interviews, the interviewer usually retains authority over the order in which questions are presented.

4.6.3. Non-participant observations

In this research, a semi-structured, non-participant observation collection method (Appendix D) was used extensively to improve the reliability of the data collected. Participants and non-participants are two categories of observations widely employed by researchers, according to Zina (2014). As stated by Bell and Waters (2014), participant observation is the researcher actively engaging in the everyday activities of a person, group, or community. This includes listening, watching, questioning, and striving to comprehend the lives of the people involved. Researchers may need to spend an extended period of time, ranging from months to years, actively engaging with a community in order to gain widespread acceptance as a legitimate member of the group (Bell & Waters, 2014). Similarly, Kothari (2004) explains, if the observer conducts observations by making himself a member of the group, he is observing with the intention of experiencing what the members of the group experience. This kind of observation is known as participant observation. Researchers who use non-participant observation do not really take part in their participants' activities, or make their presence felt, and, in this case, the individuals being watched are aware of the researcher's presence while they are doing their work (Chitiyo, Taukeni & Chitiyo, 2015). Kothari (2004) emphasises that, when the observer observes as a detached emissary without any attempt on his part to experience through participation what others feel, the observation of this type is often termed non-participant observation. For example, a researcher may sit in the back of a classroom using an observation schedule to document components of the teaching and learning activities going on and avoid showing any response to what takes place (Bertram & Christiansen, 2020: 109). Cohen, Manion, and Morrison (2011) and Korathi (2004) add that in participant or non-participant observation processes, observations can be either structured or semi-structured. In structured observation, the researcher identifies in advance the behaviours to be observed and employs a predetermined checklist. In semi-structured observation, the researcher is aware of the problem they are observing, but the observation is done in a more flexible and open manner. This

allows for the discovery of unexpected issues that may affect or be connected to the phenomenon being studied (Korathi, 2004; Cohen et al., 2011).

The semi-structured non-participant observation method was utilised to observe, and to determine, how all participant teachers use their hybrid CoPs to build their TPACK. Before commencing the observations, I conducted site visits to gain an in-depth grasp of the context in which observations would be carried out, specifically in staffrooms where staff meetings were convened. This exercise is consistent with the interpretivism paradigm, which places significant emphasis on the contextual factors surrounding a given phenomenon. Upon familiarising myself with the contextual arrangement, I initiated my observations. It is noteworthy to state that all teachers (educator populations), not only the 15 participants which included the 12 teachers, one (*n=1*) principal and two (*n=2*) deputy principals, were observed during their meetings in each of the three (*n=3*) schools. The consent of the principals was obtained, and all the in-service teachers in each of the three (*n=3*) schools were duly informed. This type of observation was deemed essential in order to ascertain the presence of TPACK discourse among educators during said meetings. The observation of all educators was conducted due to the awareness that the 15 educators may not exhibit verbal communication or interaction with their peers during meetings, and thus during meetings all staff members who attended were observed. Moreover, I took into consideration the possibility that the professional knowledge development of the 15 participants who in the study could be subject to the influence of other teachers who were not included in the sample. Thus, in order to obtain an in-depth understanding of the hybrid CoPs that encompass all educators within a school, it was imperative to conduct observations of all individuals involved as a CoP. Nevertheless, the study's primary participants consisted of a group of 15 educators.

The objective of the observations was to confirm what all 12 teachers, one (*n=1*) principal, and two (*n=2*) deputy principals reported during the interviews, by observing how all teachers (population) were operating and coping in staff meetings while attempting to build their TPACK. I specifically utilised the observation protocol during staff briefings (short meetings chaired by the principals/deputies) in the morning of each day for three weeks, the time period I had dedicated to collecting data. I also intended to observe all teachers (population) during sessions I had understood would be taking place at the respective schools. These were mooted voluntarily organised trainings by technologically skilled teachers within each school for teachers who

believed they were not adequately technologically skilled. However, no such workshops took place in any one of the three (*n=3*) schools. To be specific, I spent one (*n=1*) week at each school for observations. In order to document the activities, I used the observation protocol (Appendix D) that was created based on the study's conceptual framework (refer to Chapter 2). The observation protocol included approaches through hybrid CoPs used by teachers towards developing their and colleagues' TPACK, and the specific driving factors and constraints around hybrid CoPs in developing the participant primary school teachers' TPACK. The implementation of an observation protocol ensured that the field notes I compiled were well-organised and informative. This protocol featured designated sections for detailing approaches, factors, and constraints observed, as well as a general notes section for recording activities or incidents of interest not directly related to the practices under observation, which were facilitated through semi-structured observations. As previously mentioned, the objective of conducting these observations was to complement the one-on-one interviews by verifying, to the extent possible, whether the practices observed in the natural environment aligned with the reports gathered during the interviews. I coordinated the observation protocol in accordance with the staff meeting timetable and made necessary arrangements prior to the visits. All educators within the population were informed of the study's purpose and made aware of the observation process. One potential disadvantage of this approach is that educators may discuss the use of technology for teaching and learning at observation sessions, even if it is not something they often use in their regular practice. Nevertheless, in order to mitigate the impact of this disadvantage, I reminded teachers to try to keep their meetings natural and conduct their meetings as if I was not present as an observer.

4.6.4. Document analysis

Document analysis in a form of WhatsApp screenshots was used to collect data in this current study. Document analysis consists of analysing the contents of documentary materials such as books, magazines, newspapers, and the contents of all other verbal materials which can be either spoken or printed (Korathi, 2004). These data sources can be useful, not simply because of their content (for example, case records) but because they are also products, for example, text messages on mobile phones (Prior, 2003), and records of meetings (Denscombe, 2007). The process of document analysis refers to the unloosening of meanings in order to discover what is 'hidden in the text' (Crotty, 1998: 2). Every day many documents are created. The procedural method for

conducting the content analysis study is crafted to ensure the utmost objectivity in analysis, encompassing the identification of the material corpus to be studied and the definition of the characteristics or qualities to be assessed (Leedy & Ormrod, 2001). According to Wildemuth (2017), for anything to be classified as a document rather than merely an object, it must have a deliberate message that serves a specific function intended by its author. Documents that meet these requirements may be valuable as a data source for a research project, even if they were not originally designed to assist the investigation. They may nevertheless be beneficial for the study (Wildemuth, 2017: 231). Table 4.3 categorises and describes possible documents available for data analysis:

Type of document	**Example**	**Access**	**Typical use**
Open access	Books, journals, public statistics, certain corporate records	Libraries, online resources, government statistical offices	Scholarly research and consulting
Limited access	Medical documents, law enforcement records, internal communications, personal documents, some financial records	Negotiating with those controlling access	Consulting and scholarly research
Confidential	Confidential government documents, illicit trade, fraudulent financial records, corporate strategies	Insider information, deceitful participation	Journalistic investigation, fraud identification, covert operations

Table 4.3: Access to documents for research

As it can be seen in Table 4.3 above, when documents are part or researchers' data collection methods, researchers must engage in negotiations with data holders to convince them to provide the researcher the privilege of accessing the content. This claim is consistent with O'Connor (2019), who advocates that document analysis involving personal information (such as diaries) or confidential material (such as health and education records) would, however, necessitate permission for access from the individuals involved together with stringent ethical approval on several issues, including informed consent, anonymity, and storage of data. Therefore, in the case of this current study, I requested and received permission to access the participant teachers' online group chat (staff WhatsApp group) from the principals of the three (*n=3*) schools. It is crucial to clarify that I did not have direct access to these WhatsApp groups; nonetheless, I was provided with screenshots of the discussions, notably the historical chats that concerned the use of technology tools for teaching and learning. One teacher from the participating teachers at each school volunteered to share the relevant screenshots with me through private WhatsApp texts. My task was to probe the data that could help to identify those important aspects that could be used to explain and describe what constituted the texts under investigation. In the process of my textual analysis, I concentrated on descriptive, common and unusual ideas, phrases and words, and their meanings. This method is representative of qualitative work and is one which 'enables analysis and interpretation of the text' (Jones, Torres & Arminio, 2016: 85). This method was mainly used to support data collected through other means or methods, as can be seen in 4.6.1, 4.6.2, and 4.6.3, where Marshall and Rossman (2011) are cited and show their emphasis on the possibilities of documents to being used as data sources or to supplement other methods of data collection. Document analysis provides researchers with opportunities to analyse texts, images, and speech acts critically, in order to challenge the assumed, often biased or unjust assumptions, and the 'common sense' shared ideologies which inform them (O'Connor, 2019: 67). In this sense, in this current study, and other studies, O'Connor (2019: 67) suggests certain key questions to ask when approaching data from any discourse analysis perspective:

- Why are these words or images being used and not others?
- What is being assumed or implied about the subject in this discourse material?
- What shared cultural or social knowledge is allowing the investigator to understand and make meaning from it?

- How are individuals or groups of people being positioned in this material?

All the texts related to the phenomenon of the study were analysed, regardless of whether they were sent by some of the 15 participants or by other teachers within the school community. As mentioned in the previous section, the professional knowledge development of the 15 participating educators may also be influenced by other teachers who are not necessarily part of the primary participants in this study. Therefore, to get a clear and full picture of the complete hybrid CoPs established by all teachers within a school, it was necessary to analyse each and every text relevant to the study's phenomenon. The screenshots were printed and were then analysed through a search for meanings that construct the language of these documents. Meanings that I found to underscore these texts were couched in broad themes that can be found in the conceptual framework of the study and which include concepts of CoP social learning theory, Strong and Weak Tie Theory and TPACK model. Basically, since this is a qualitative study, I read all the printed screenshots in the sample with care and coded them according to categories which related to the participant teachers' utilisation of CoPs in developing their TPACK. This coding was done using coloured highlighter pens to identify extracts or quotes with similar themes. Throughout this process I was mindful that teachers may share images and videos in the group chats, and in such cases I indicated these in the findings. Common themes and patterns were identified in the discourses and terminology uses was noted.

Document analysis of WhatsApp text was valuable to supplementing and strengthening data already collected using the three data collection tools: survey questionnaire, interviews, and observations. In other words, these methods were linked together as data collection instruments to form a complete and reliable picture. The data from documents (printed screenshots) was triangulated with the data from interviews, observations, and survey questionnaires. I chose this specific approach as it enabled and encouraged participating educators to provide detailed descriptions of their personal experiences using hybrid CoPs to enrich their own and/or their colleagues' TPACK. Table 4.4 illustrates how I structured, analysed, and identified trends in the gathered data in alignment with the subsidiary research questions.

Research questions	Method
1. What innovative approaches to form hybrid CoPs are being used by participant primary school in-service teachers in developing their TPACK?	Survey questionnaires Observations Interviews Document analysis
2. What are the driving factors and constraints around hybrid CoPs in developing these primary school teachers' TPACK?	Survey questionnaires Observations Interviews Document analysis
3. What specific strengths were evident in the relationships of these in-service teachers within their hybrid CoPs while they were learning TPACK from one another during the recent COVID-19 pandemic?	Interviews
4. In what specific ways could primary school teachers, such as those in the current study, be supported and assisted to build the knowledge required for their successful teaching with technology through their participation in hybrid CoPs?	Findings from sub-questions 1, 2, and 3.

Table 4.4: Data collection methods used to answer the research questions.

4.7. Data analysis

In this current study I analysed data qualitatively. Analysis of data in a general way involves several closely related operations which are performed with the purpose of summarising the collected data and organising these in such a manner that they answer the research question(s) (Kothari, 2004). Miles et al. (2014) suggest that effective analysis of qualitative data necessitates researchers to possess the ability to interpret the collected data in order to derive meaningful insights relevant to their research questions. In essence, data analysis is characterised as a procedure aimed at organising, structuring, and attributing significance to the collected data (Biggerstaff & Thompson, 2008). Building on these claims, Madondo (2021) is of the view that data analysis is the most complex and mysterious of all the phases of a qualitative project, and the one that often receives the least thoughtful discussion in the literature. This was apparent in Culén (2010), who argues that data analysis is a messy, uncertain, and time-intensive endeavor, albeit crucial and captivating. In order to generate findings that transform raw data into new knowledge, a qualitative researcher needs to engage in active and demanding analysis processes throughout all phases of the research (Madondo, 2021).

Flick (2020) describes qualitative data analysis as taking place when a researcher classifies and analyses linguistic or visual information in order to be able to make claims about implicit and explicit dimensions and patterns of meaning-making in the material, and what is represented in it. This type of data is common whenever people are the focus of a study, particularly in social groups or as individuals (Walliman, 2018). De Vos (2002), like Culén (2010), argues that qualitative analysis can be a very time-consuming and chaotic process which is at the same time greatly rewarding and intriguing. De Vos (2002) further adds that analysis of data gathered in the form of hundreds of pages of field notes or extended audio recordings may be a daunting endeavour for a qualitative researcher (De Vos, 2002). Therefore, as recommended by Thomas (2011), in order to avoid, or reduce these difficulties, data analysis for the current study began as soon as the data-gathering phase was complete. Given the emphasis of this study on individuals' lived experiences, qualitative data analysis was fitting for uncovering the meanings people attribute to events, processes, and structures in their lives, and for understanding how these meanings relate to the social environment in which they unfold. I considered that an interpretivism paradigm, case study

design, and qualitative data analysis would all work well together since the goal is to learn more about the phenomenon under study.

Vogt, Vogt, Gardner and Haeffele (2014) note that, within a qualitative study, researchers may choose to analyse data inductively, deductively or a combination of both methods. In order for me to collect thorough and rich data, both inductive and deductive reasoning were applied in the current study. When using an inductive technique, the researcher examines the data without having a planned topic or theory in mind, as opposed to a deductive strategy, which examines the data in light of a predefined theme or theory (Zina, 2014). In other words, inductive reasoning may be used by a researcher if very little is known about the situation, its context, its driving forces, and in the absence of previous theories (Walliman, 2018). Without any preconceptions, the researcher begins with collecting the data from the situation under study and goes on to examine and explain the underlying processes to gain an understanding of what the factors or dimensions of the situations, and from this, generates a theory which summarises or serves to explain this situation and its workings (Walliman, 2018). With a deductive approach, researchers intend to test a theory by collecting the fresh data from respondents and observing, or coming up with, the findings by applying various statistical tests (Rahi, 2017). This method is generally recommended for specific studies in which researchers work on a concept by creating assumptions and then verifying those assumptions (Rahi, 2017).

I incorporated both inductive and deductive approaches in this current study, while acknowledging that interpretivists adopt an exploratory, holistic, and inductive approach to data processing, rather than relying on statistical analysis (Cohen et al., 2007). However, Zina (2014: 130) states that, in qualitative research, a researcher may employ both inductive and deductive reasoning, may admit subjectivity, embrace a variety of perspectives and realities, and understand the effect of the study on both participants and researcher. In this case, regarding the deductive approach, I pre-determined the study's conceptual elements of CoP social theory of learning, Strong and Weak Ties Theory, and the TPACK model. Regarding the inductive approach, I organised the gathered data, which emerged without anticipation or preconception, into meaningful categories. The conceptual framework directed me to identify codes for arranging the data as it was collected, while I also intentionally remained receptive to any unexpected themes that arose during the research process

Before data analysis could start, audio recordings of interviews were translated from Isixhosa to English and transcribed. Data transcription refers to the procedure of transforming audio recordings or field notes into written or typed format (Creswell & Guetterman, 2019). This process entails fully transcribing the verbatim words spoken by the participants during the interviews. Following transcription, the transcripts underwent thorough analysis as part of the data analysis process. The responses to open-ended questions in survey questionnaires, interviews, observations, and certain documents (WhatsApp screenshots) underwent qualitative analysis using computer-assisted qualitative data analysis software (CAQDAS) rather than manual analysis. However, due to limitations in the software's capabilities, certain WhatsApp screenshots, particularly photos shared in these group chats required manual analysis. I followed certain steps in the process of analysing the data using CAQDAS Atlas.ti. ATLAS.ti is a computer programme specifically designed for analysing qualitative data. In most cases, researchers utilise the ATLAS.ti programme to analyse a wide variety of qualitative data, including field notes, observations, interviews, and other textual sources (Feza, 2015: 470). I considered Atlas.ti to be an effective computer software programme for my purposes since it had functions such as data storage, data organisation, labelling or coding, data searching, and code report retrieval (Creswell & Guetterman 2019: 241). The following systematic steps recommended by Creswell and Guetterman (2019: 241) were used in this current study to analyse data using the ATLAS.ti computer software programme:

- First, word-formatted transcripts were organised and kept in a computer. Raw data was organised separately; for example, there was a separate file for each survey questionnaire, interview, observation or WhatsApp screenshot document;
- Second, each file was then imported/ uploaded directly into the ATLAS.ti software;
- Third, I went through each file and highlighted relevant sentences or paragraphs of ideas;
- Fourth, I assigned a code label to the blocked text, and this process was repeated throughout the entire text files;
- Fifth, after blocking and labelling text, I searched for all text matching each code and read a code report of these text passages;
- Sixth, I was able to compress the code labels into a few broad themes or groups and add evidence for each category.

The software guided me in navigating through various documents by establishing a hierarchical system of codes assigned to the text. These codes were utilised for data retrieval through query tools and for visualising emergent concepts, thereby imparting meaning to the data. Additionally, the Atlas.ti programme facilitated the recording of interpretations and activities during the data analysis process using its memo feature. Although several options for qualitative data analysis software were available, Atlas.ti was chosen primarily due to my familiarity with the programme, stemming from my participation in workshops and training sessions organised by CPUT. These trainings equipped me with the necessary skills to effectively utilise the software. Organising the data both before and after analysis is considered crucial in research, as emphasised by Creswell and Guetterman (2019: 238), especially given the substantial volume of data typically collected in studies such as the present one. Moreover, as highlighted by Bazeley and Jackson (2013), careful consideration of data management approaches and requirements before data collection is essential, as they can significantly influence the subsequent analysis process, including data sorting, comparison, and querying capabilities. To ensure data security and integrity, all audio-recorded interviews were kept in password-protected electronic files. Observational notes were arranged separately in a locked file drawer, and duplicate copies of all data forms were stored in distinct locations.

4.8. Trustworthiness

In this current study, to ensure trustworthiness, I addressed the issue of credibility, reliability, transferability, and confirmability. Guba and Lincoln (1981) recommend that in research done in accordance with the interpretivism paradigm, the positivist criteria of internal and external validity and reliability should be substituted for these four trustworthiness criteria mentioned above.

4.8.1. Credibility

Credibility was ensured in this current study. According to Polit and Beck (2012), credibility pertains to the accuracy of the data or the viewpoints of the participants, along with the researcher's capacity to precisely comprehend and communicate these aspects. The researcher's capability to articulate their experiences as a researcher and to corroborate the study findings with the participants both contribute to the researcher's overall credibility (Cope, 2014). According to Hastie and Hay (2012), the most important factor in determining whether or not a set of findings

can be trusted is whether or not these findings provide an accurate reflection of the situation. I used triangulation as a technique in this investigation so that the findings would have more weight and be more credible. According to Hastie and Hay (2012), this technique entails using a variety of different approaches to collecting data. Also, Abdalla, Oliveira, Azevedo, and Gonzalez (2018), and Holloway (2016), point out that there are four different forms of triangulation: Triangulation of methods involves employing diverse data collection techniques to gather data and address research inquiries. Triangulation of data sources entails collecting data from various sources and at different time points to achieve a more comprehensive and detailed understanding of the phenomenon, as well as to verify the consistency of the collected data obtained from two or more sources. Triangulation of investigators involves incorporating multiple interpretations of the research findings. Triangulation of theories involves utilising multiple theoretical frameworks to examine the same phenomenon.

In this current study, in terms of triangulation of methods, four data collecting methods were employed to gain an articulate, comprehensive view of the phenomenon: self-administered hardcopy survey questionnaires, one-on-one interviews, teacher observations, and document analysis. Regarding the triangulation of data sources, member checking was utilised to ensure credibility. Member checking involves sharing the final research report with participants, allowing them to verify the accuracy of the findings derived from their interviews (Creswell, 2014). Therefore, member checking enabled participants to review whether the transcripts faithfully represented the content of their respective interviews. In addition, triangulation of data source was achieved through collecting data in different days and at different times from 15 participants to obtain a richer and more detailed description of the phenomenon. Most importantly, to ensure credibility, I made sure that there was a thorough data collection and meticulous field work through prolonged engagement, persistent observation, and reflexivity. Prolonged engagement is the process of building trust and rapport with participants to foster rich, detailed responses (Cope, 2014). I promoted the prolonged engagement process by allowing adequate time for the collection of the data and for obtaining an understanding of both the participants and the phenomenon of the study. In terms of triangulation of theories, triangulation was achieved by using three ($n=3$) theoretical frameworks in the interpretation of the phenomenon. The various actions undertaken collectively contributed to gaining a deep understanding of the unit of analysis, thereby facilitating the interpretation and presentation of the data. The described measures in this study serve to instil

confidence in the methods utilised, the data collected, and the subsequent data interpretation, thereby enhancing the overall trustworthiness of the research.

4.8.2. Transferability

Transferability refers to the extent to which the study, along with its findings and conclusions, can be applied to a different setting or settings (Creswell, 2014). This implies that the insights gained in one context can be applicable to similar situations or participants. Knowledge obtained in one context is highly likely to be pertinent in another, and researchers conducting similar studies in different contexts can apply certain concepts originally developed by other researchers (Holloway, 2016). Transferability in this current study mostly relied on my thick descriptions as a researcher. These included contextual information about the research site. The research site and the participants have been stipulated and described in detail. The methods and timelines for data collection are thoroughly outlined, including the overall duration of the field study (Stahl & King, 2020). These aspects impact the extent to which the research findings may be applicable to other sites or contexts (Stahl & King, 2020). Hence, I believe this information can guide other researchers in understanding the scope within which data was gathered and analysed.

4.8.3. Dependability

In this current study, I made every effort to ensure dependability, as suggested by Morgan and Drury (2003), by detailing the ways in which qualitative research can attain an appropriate level of research dependability. I consider that this dependability has been achieved by my explanation of the methodological framework and the range of strategies that have been used within this study. The rationale for the way in which participants were selected has also been described, as well as my role as a researcher and my perceived relationship to the participants. It was necessary to document analytic constructs and meanings which derive from data, alongside the methodological approach and procedures that were used for producing data. This process included providing descriptions of the phenomenon with a narrative appropriate to the social context in which they occurred, particularly in terms of persons, places, and events. Theoretical propositions are also fully explained in terms of how constructs have been formed through detailed procedures. As suggested by Ali and Yusof (2011: 34), I took all of these actions to reassure that another researcher investigating the same issue, or working with the same data set, would derive the same or very

similar findings. This procedure is consistent with that of Hastie and Hay (2012), who argue that, when a researcher takes into consideration the constantly shifting environment in which research takes place, or how his/her study's conclusions differ from those of earlier studies, his/her study can be said to be dependable (Bertram & Christiansen, 2020).

4.8.4. Confirmability

In order to maintain confirmability in this current study, I chose to uphold the audit trail through MS word. This document (Appendix F) included detailed accounts of each research meeting. Whether these meetings were with research supervisors, principals or teachers of the three (*n=3*) schools involved, the research decisions were made throughout the process. By using an MS word document, I was able to type and save the document in the computer and external drive and I was able to go into and add to the document at any time, providing an efficient way to maintain a detailed account of the project from beginning to end. In addition, the acceptance of the accuracy of the results of the study rests on the use of the four (*n=4*) robust and verified data collecting instruments indicated at an early stage in the data collection process. In this process, as pointed out by Creswell (2014), member checking was implemented via a process which provided the participants with an opportunity to check and evaluate their responses to the survey questionnaires and to the interview questions. Lietz and Zayas (2010) argue that there are several strategies that a researcher can use to increase a study's confirmability. These include member checking, peer debriefing, and audit trails (keeping a detailed written account of the research procedures). To ensure the accuracy of the transcription, I cross-checked the transcripts with the audio recordings (Lietz & Zayas, 2010). After my review, minor inconsistencies, like spelling errors and the clarification of acronyms, were corrected in the transcripts (Lietz & Zayas, 2010). The confirmability of a study is an indication that the researcher has established the truth of the results (Stoner, 2010: 28). One would argue that the implication provided by this definition is that confirmability refers to the ability of others to confirm or corroborate the findings.

4.9. Ethical consideration

Ethical considerations include paying attention to the way in which the research is presented to potential participants, the likely impact on a participant(s) of taking part in research (both for individuals and pre-existing groups), the effect on participants and institutions/ groups of which they are members of sampling strategies, engaging with the researcher (and other participants),

and dissemination sessions (Barbour, 2008). Atkins and Wallace (2012: 30) add that ethical considerations imply giving consideration to issues/questions, such as 'how will the researcher respond to any unexpected ethical issues?' – since there almost always unexpected ethical issues arise, some of which can be life-changing for the individuals concerned and which thus places a researcher in a position of great moral responsibility. According to (Christian, 2005: 144) there are several basic principles which inform and are the basis of ethically sound research:

- Informed consent signifies that individuals should not be involved in research as participants unless they are aware of it and have the opportunity to decline participation.
- Researchers should avoid deceiving participants, whether through covert observation or by providing false information about the research's purpose.
- Participants' privacy must be honoured, and confidentiality must be ensured and upheld.
- Upholding the accuracy of data and its interpretation should be the primary principle, ensuring that no omission or fraud occurs in the collection or analysis of data.
- Respect for individuals is considered paramount in relation to participants.
- Beneficence, which means considering the well-being of the participants, is essential.
- Justice, which addresses the relation of benefits and burdens for the research participants should be applied at all times.

Basically, ethical considerations are about the researcher's understanding of how to safeguard those who are ready and eager to participate in a study. Therefore, the considerations in this current study were firmly adhered to in the following process: The Ethics Committee of the Faculty of Education at CPUT, together with the WCED were notified, and written approval (as seen in Appendix G and Appendix H) from these institutions was acquired prior to the start of the research. Flick (2007) argues that most research has to be approved by institutional review boards. As qualitative research is almost always research involving human beings in one way or the other, it has to be subjected to examination by institutional reviews quite regularly (Flick, 2007). Approval by ethic commissions or institutional review boards is linked to assessing the quality of (planned) research in a specific way, or to assessing specific aspects of quality of research (Flick, 2007). Flick (2007) further explained that most professional organisations of researchers have formulated and published their codes of ethics, and these codes of ethics represent an additional way of institutionalising a check of the quality of (planned) research in its ethical dimensions. In this

current study, adherence to the University's research ethical standards necessitated the submission of the research proposal to the Ethics and Higher Degrees Committees for ethical clearance. Ethical clearance serves the purpose of safeguarding human participants from harm and upholding their dignity throughout the research process. Permission (see Appendix I) was also sought from the schools' gatekeepers, in this case, the school principals of the three (*n=3*) primary schools, who facilitated my access to the populations.

After acquiring the necessary permission in writing (see Appendix J) from the principals of the selected public primary schools, an informal meeting with all educators (population) at each school was convened to discuss participants' requirements and the overall goal of the research with participants at prior to the commencement of the study. This occurred at the beginning of the research process, during the participant selection process, when survey questionnaires were distributed for use as the primary technique for sampling. At the start of data collection, consent forms and printed survey questionnaires were provided to all 89 in-service teachers. However, upon my return to collect the documents, only 27 completed copies, accompanied by signed consent forms, were returned. It's crucial to emphasise that issuing consent forms to all teachers was pivotal as it marked the beginning of data collection, with the survey questionnaires mainly serving to identify potential participants. Consequently, only 12 teachers later served as primary participants. Educators were given consent forms which they were asked to sign on an entirely voluntary basis. The consent forms provided comprehensive information about the study's nature and objectives. Participants' signature on the consent forms signified their full understanding of the research project and their voluntary participation in it. The consent forms also outlined participants' right to withdraw from the study at any point without facing any negative consequences. Prior to any data collection through survey questionnaires, interviews, observations, or document analysis, participants received detailed explanations about the study's objectives and procedures. A key aspect of this to be aware of is that very few participants have the same level of understanding of the research process as the researcher has. This factor made it morally incumbent on myself as the researcher to anticipate any possible harm, distress or change which might be experienced by the participants since the participants could not be expected to either anticipate these, or to be aware of their possible implications (Atkins & Wallace, 2012).

I adhered to possible privacy issues. For example, confidentiality and anonymity are two aspects of the privacy issue. Confidentiality means that the identity of the participants was not disclosed to anyone (Marvasti, 2004). Thus, in the current study, to keep their identities hidden I refer to research participants by using fictional names such as Teacher A, B and so on. Other identifying information, such as where they live, or work was also disguised. A further ethical dilemma arose from the possible disclosure of educators' and schools' identities in WhatsApp screenshots. Thus, the names of educators and schools were hidden on the WhatsApp screenshots acquired from the participating schools to prevent the identification of the participating educators. To prevent the disclosure of sensitive material discussed on the schools' WhatsApp group, teachers shared the posts exclusively with me, via private WhatsApp messages. These were the necessary screenshots pertaining to the aim of the research. Participant and school rights and well-being were protected by ensuring that no participant or school was placed in a position where they were likely to suffer harm, whether harm to their reputation or in the form of a threat to their physical safety or well-being. At the very least, the research participants were informed in advance about the types of questions they would be asked and reminded that they had the option to decline to answer certain questions or to end the interview whenever they wished (Marvasti, 2004). In terms of anonymity, since the interviews were taped, the audio recordings were not labelled with the respondents' actual names. Instead, fictional names were used. Similarly, a set of pseudonyms for all the research participants were used in the observation notes and information from document analysis in place of their real names.

Bulmer (2008) argues that ethical concerns serve as a deterrent against the creation or alteration of data, in this way fostering the quest for knowledge and truth, which is the fundamental objective of research. The present research used member verification to avoid fabrication and dissemination of erroneous information. I implemented member checking by providing the participants with the chance to see interview transcripts to validate the accuracy of their replies during the interviews (Creswell, 2014). To enhance the safety of the gathered unprocessed material (including notes and recordings), and the subsequent transcription, I stored them in computer folders that were secured by passwords, thus granting me exclusive access. Given that I was a teacher at one of the schools where the data were gathered, I recognised the possibility of interviewer bias and conflicts of interest. For instance, I may have my own views, understandings, and attitudes towards the school and teachers, which might lead to the risk of bias and therefore alter my professional

interaction with the participants. To eliminate bias as far as possible, I ensured that participants had the opportunity to highlight any inaccuracies they perceived, and/or to request portions of the interview transcripts be deleted.

4.10. Chapter summary

This chapter discussed the methodology employed to help answer the research question: *How and to what extent are current hybrid CoPs being used in a sample of primary schools to influence the development of in-service teachers' TPACK?* The interpretivist research paradigm and the qualitative methodological approach of the study were elucidated and justified. Various research study designs were briefly deliberated upon, and the rationale for opting for the multiple case study design for this study was examined and endorsed. The three case studies enabled an in-depth analysis of a small sample comprising of 12 teachers, one (*n=1*) principal at one school, and two (*n=2*) deputy principals at two schools, respectively. This was achieved by making use of four data collection tools which included survey questionnaires, one-on-one semi-structured interviews, staff meeting observations, and discourse analysis in the form of WhatsApp screenshots for triangulation purposes. The chapter provided an in-depth portrayal of the educator participants engaged in the study. It also expounded upon the data analysis methodologies employed. Finally, the chapter concluded with discussions on the study's trustworthiness and the ethical principles upheld throughout the research. Figure 4.1 presented below offers an overview of the research and indicates the current status of its progress. In the next chapter, the collected data are analysed.

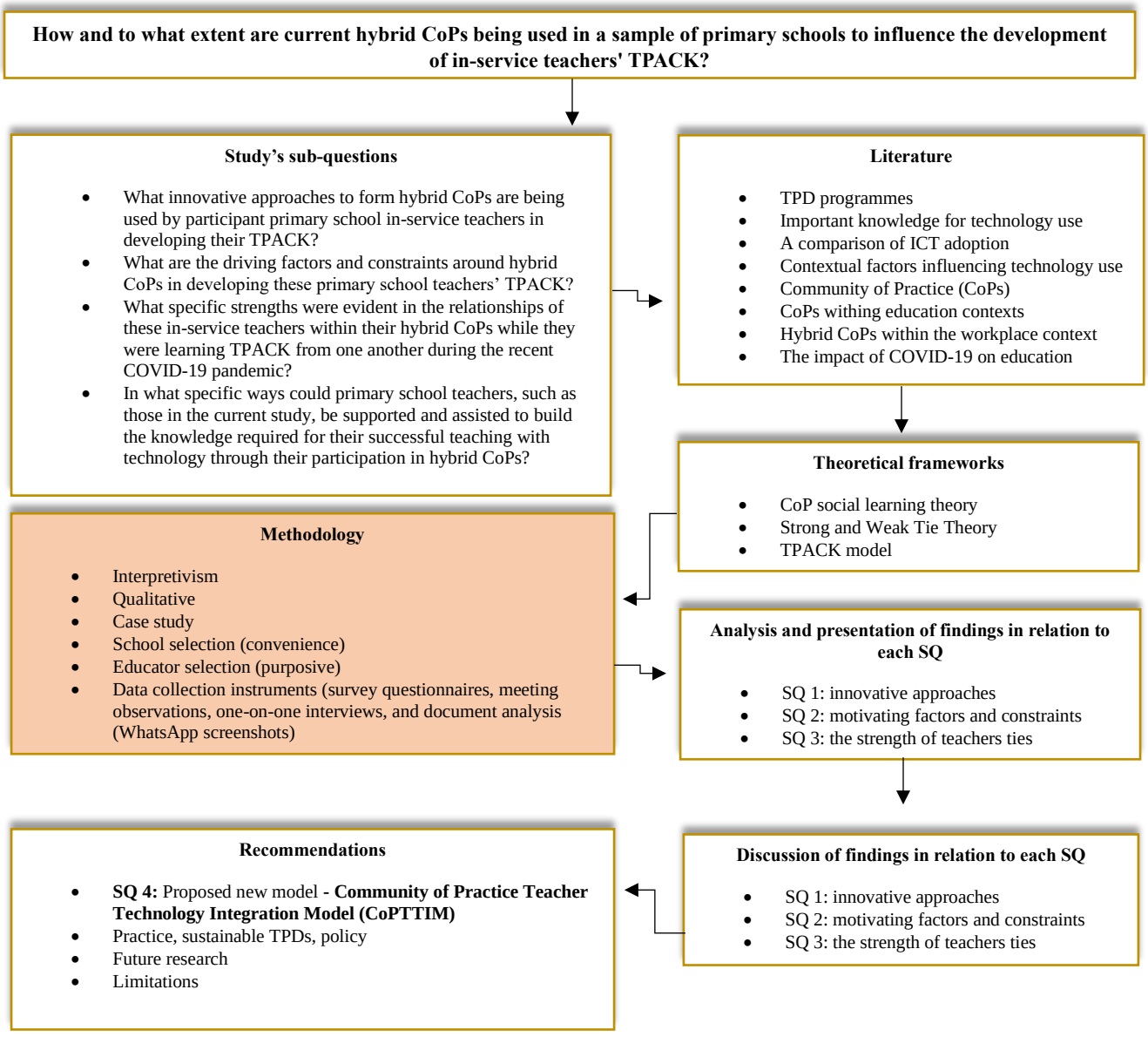

Figure 4.1: Overview of the research and indicates the current status of its progress

CHAPTER 5: RESEARCH FINDINGS

5.1. Introduction

In this chapter, the findings derived from the collected data are presented, as outlined in the preceding chapter, the data were collected using open-ended survey questionnaires, document analysis of WhatsApp screenshots, observations of meetings, and semi-structured interviews with the selected teachers, one (*n=1*) principal, and two (*n=2*) deputy principals at the three (*n=3*) selected public primary schools, respectively. The findings, and their interpretation/analysis, are informed by the CoP social learning theory and supplemented by the Strong and Weak Tie Theory, and the TPACK model as the theoretical frameworks of the study. The aim of the study was to investigate the influence of hybrid CoPs on the development of a group of primary school in-service teachers' TPACK in a historically disadvantaged area of Khayelitsha in the Western Cape province of South Africa. Based on interpretations of the findings, the chapter presents a response to the main research question: *How and to what extent are current hybrid CoPs being used in a sample of primary schools to influence the development of in-service teachers' TPACK?* Included in the chapter is a response to the following subsidiary questions:

- What innovative approaches to form hybrid CoPs are being used by participant primary school in-service teachers in developing their TPACK?
- What are the driving factors and constraints around hybrid CoPs in developing these primary school teachers' TPACK?
- What was the nature and degree of the strengths of these in-service teachers' relationships in their hybrid CoPs while they were in the process of learning TPACK from one another during the recent COVID-19 pandemic?

These questions are further presented in Figure 5.8. It must be noted that the fourth subsidiary question*, "In what specific ways could primary school teachers, such as those in the current study, be supported and assisted to build the knowledge required for their successful teaching with technology through their participation in hybrid CoPs?",* is only discussed in Chapter 7 (seven) as part of the recommendations since the aim of this question was to recommend new a model, based on the findings of this study, which might be used by certain public primary schools to naturally and sustainably develop teachers' TPACK using hybrid CoPs (see Section 7.4). The CoP

social learning theory was used to inform the answers to the first and second subsidiary questions. Regarding subsidiary question one, the CoP social learning theory was specifically used to identify, from the findings, the dimensions/approaches used in and by hybrid CoPs to develop a group of primary school in-service teachers' TPACK. With regard to the second subsidiary question, the CoP social learning theory was also used specifically to identify, from the findings, the four components which could act either as driving factors and/or constraints in hybrid CoPs during the process of teachers' TPACK development. The Strong and Weak Ties Theory was used to inform the answers to the third subsidiary question, specifically, by identifying, from the findings, the types of ties derived from the participant in-service teachers' interactions with one another in their hybrid CoPs as in the course of their acquiring and using TPACK. Moreover, the TPACK model and the Strong and Weak Tie Theory were used across all three subsidiary questions to specify the type of knowledge teachers were learning and to determine the strength of ties between teachers in their respective hybrid CoPs while they were acquiring this knowledge. Nevertheless, I remained receptive to data that did not necessarily fall within the confines of the three theoretical frameworks used in this study.

5.2. Research sub-question one

What innovative approaches to form hybrid CoPs are being used by participant primary school in-service teachers in developing their TPACK??

In the response to the first subsidiary question, the identified dimensions (approaches) are analysed to understand the role of these approaches in the formation of hybrid CoPs in the course of developing the participant public primary school in-service teachers' TPACK. As highlighted in Chapter 2 by Baya'a et al. (2019), Chigona (2013), Jho et al. (2016), Wenger (1998) and Xu and Ko (2019), mutual engagement, joint enterprise, and shared repertoire plays a primary and vital role in the formation of CoPs as seen in Table 5.1 below. As a result, a CoP may be characterised by these three dimensions. These dimensions emerged from the data as themes to analyse the findings in this section (see Figure 5.1 below).

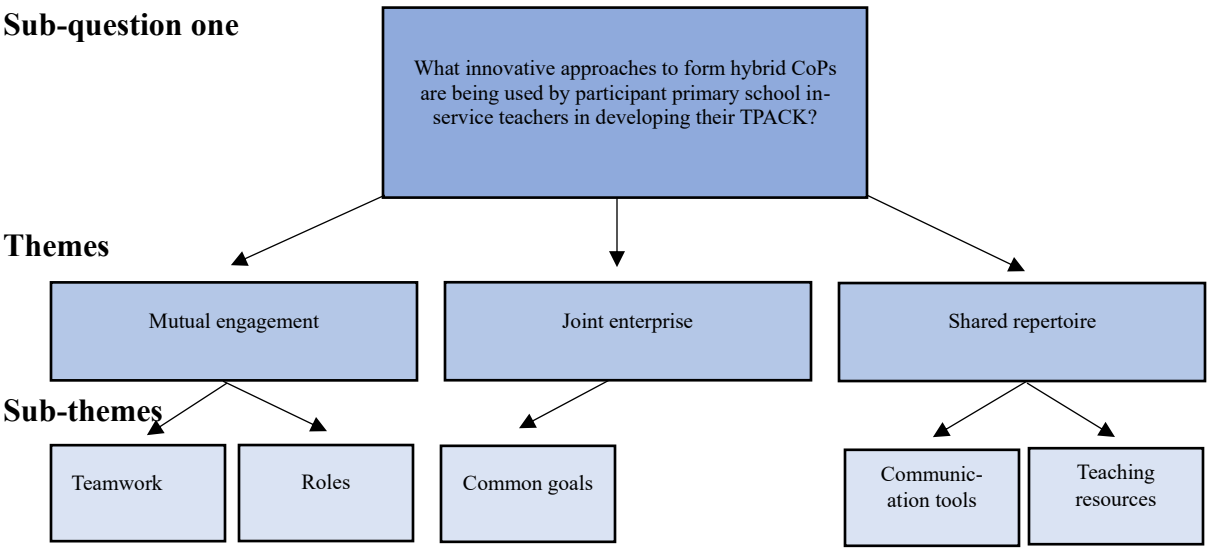

Figure 5.1: sub-question one themes

Table 5.1 below represents only the data collected from the survey questionnaires and the interviews with the participants. The symbol 'X' in the table indicates that the participants mentioned and/or implied in their responses that a particular dimension (approach) was involved in the formation of their hybrid CoP, while, at the same time, their TPACK was growing through their participation. The data from observations and document analysis of screenshots mentioned earlier in Chapter 4 are not included, since the aim of these data collection tools was to look not only at the 15 participants who were primary participants of the current study, but also at the entire population of teachers at these three (*n=3*) schools. However, to explain and analyse these dimensions (approaches) in detail, data from the participants' meeting observations and document analysis (WhatsApp screenshots) were used to supplement the survey questionnaires and interviews.

Schools	teachers	Data collection tools	Mutual engagement		Joint enterprise	Shared repertoire			
			Mutual support & Teamwork	Roles	Common goals	Communication tools			Teaching resource
						WhatsApp	Facebook	e-mail	
A	A	Questionnaire	X	X					
		Interview	X			X	X	X	
	B	Questionnaire							
		Interview		X	X			X	X
	C	Questionnaire	X		X				
		Interview		X	X	X			X
	D	Questionnaire	X						
		Interview	X	X		X			
	E	Questionnaire	X		X				

B		Interview	X	X		X		X	X
	F	Questionnaire	X	X					
		Interview	X	X		X		X	
	G	Questionnaire	X	X					
		Interview				X		X	
	H	Questionnaire	X	X					X
		Interview	X	X		X			X
C	I	Questionnaire							
		Interview	X			X		X	
	J	Questionnaire	X						
		Interview	X			X			X
	K	Questionnaire	X	X					
		Interview	X			X		X	
	L	Questionnaire	X						

		Interview	X	X	X				
Principal/deputy	A	Interview	X		X				
	B	Interview		X					X
	C	Interview		X		X			

Table 5.1: Innovative approaches (Wenger, 1998).

5.2.1. Mutual engagement

Mutual engagement, as explained in Chapter 3, section 3.2.1.1 by Jho et al. (2016), refers to the continuous contact between members of a community, along with the roles and ties that arise from this interaction. In Chapter 3, Wenger (1998) observed that members of a CoP connect with one other and establish a shared practice via collaborative teamwork. Through analysing the data collected from the open-ended survey questionnaires and from interviews with the participants, it was observed that teamwork and the roles of educators emerged as sub-themes (refer to Table 5.1) related to mutual engagement. These findings shed light on the ways in which the participant teachers formed and utilised hybrid CoPs to enhance their TPACK.

5.2.1.1. Teamwork between educators

Teamwork and engagement were shown to be crucial aspects in facilitating the development of these teachers' hybrid CoPs to enhance important knowledge, as indicated by the open-ended survey questionnaires and one-on-one interviews with the participants. Nine (*n=9*) out of 12 teachers (A, C, D, F, G, H, J, K, and L) indicated in their survey questionnaire that there was teamwork taking place among the teachers at their schools, as shown in Table 5.1. This finding was also corroborated by nine (*n=9*) (see Table 5.1) out of 12 teachers in the interviews, and this can be seen in the selected teachers' comments below:

Teacher D at School A:

> "If I have a problem, I may go to a person that I share a subject with if its content related, or maybe it's something that has got something to do with the learners and discuss whether he/she has ever experienced a certain behaviour of a learner or it's only me. Even if I find out that it only happens when I am there. I must escalate it to the HOD and staff to find the cause of such a behaviour."

Teacher E, at School B:

> "Yeah. I can say at the beginning of the year in our school we are rotating the subjects. So, at the beginning of the year, we share information maybe something that we used previous year and the resource file, and we share among teachers, and we share information about how we can teach the subject better using our previous lesson plans."

Teacher L at School C:

> "Yes, there has been teachers from other schools who have asked for help. And, I have asked for help from other schools. For instance, as I talked about a program that I'm using which I got from other school. And the reason we have MCO I spoke with teachers from other schools. And Clicks program it's because of the communication with teachers from other schools."

Consistent with the above teachers' interview responses, Principal A at School A stressed:

> "… when they are planning, they plan together…"
>
> "We do that. We do liaise with other schools when we are having something we're not familiar with, like those programs, or maybe we don't seem to follow in a particular meeting, we do communicate with them. Or to inquire about things like internet. When it is down or low we check with them to find about the status of theirs".

The educators' remarks align with the findings presented by Lecat et al. (2020) in Chapter 2, Section 2.1. The authors define informal learning or training as the intentional or unintentional engagement of teachers in individual or collective, interactive or non-interactive, and instructive or self-directed activities that enhance their knowledge and skills. Participants' comments above also indicate a sense of bonding among teachers for the purpose of sharing information in relation TPACK and this gives an indication of strong ties between these teachers. The most intriguing aspect of the educators' remarks is that TK emerged as the predominant common knowledge among teachers, as demonstrated by the replies of teachers A, B, D, J, and Principal A. The following PK, which was implied by Teachers A and I, and CK, and was identified by teachers D and E, is shown in Table 5.2.

Types of knowledge emerged as a result of Teamwork								
schools	**teachers**	**TK**	**PK**	**CK**	**TPK**	**TCK**	**PCK**	**TPACK**
A	**A**	X	X					
	B	X						
	C							
	D	X		X				
B	**E**			X				
	F							
	G							
	H							
C	**I**		X					
	J	X						
	K							
	L							
Principals/deputy	**A**	X						
	B							
	C							

Table 5.2: Types of knowledge shared through Teamwork in teachers' hybrid CoPs

It must be noted though, that there is not always a spirit of teamwork among teachers in schools, and this was evident from the survey questionnaire responses of four (*n=4*) participant teachers out of 12, of which two (*n=2*) are from school B (Teachers E and F) and another two (*n=2*) from School C (Teachers I and L). In a nutshell, these teachers responded in their survey questionnaires that they did not believe that teachers at their respective schools were united and work together. Another intriguing aspect of this discovery was the remark made by Deputy Principal A, which highlights that teamwork or collaboration extends beyond educators inside the same school. In fact, it may include educators from surrounding schools as well. In other words, teachers take advantage of bridging to hybrid CoPs other than their immediate hybrid CoP which is within the school in which they are employed. This provides evidence of weak ties between teachers from different hybrid CoPs. This was further shown in Teacher L's survey questionnaire answer at School C, where he elucidated that he consistently engaged in collaborative efforts with educators from other schools whenever he required assistance pertaining to curriculum matters. This finding aligns with the research conducted by Mahlo and Waghid (2022) and by Hargreaves (2021) as reported in Chapter 2, Section 2.7. These researchers found that multiple schools within a particular region may together establish a CoP to support their teachers by facilitating the sharing of resources, knowledge, and innovative ideas. The researchers (Mahlo & Waghid, 2022; Hargreaves, 2021) respectively found the aim of this teamwork effort was to address challenges faced by schools that have not fully embraced technology as a tool for teaching and learning. In this current study the data I obtained from teachers' short meeting observations respectively at Schools B and C reveals a strong culture of teamwork in these schools. Furthermore, it is important to highlight that teachers may also establish ties with non-teaching or supportive personnel, such as receptionists, as mentioned in Teacher F's response at School B. These results indicate that teachers utilise cooperative teamwork to form and sustain their hybrid CoPs whose purpose is to enhance their TK, PK, and CK. Thus, from the literature and from my own study, what can be seen is that the mutual engagement component is a specific approach used by many teachers for this purpose.

5.2.1.2. Members' roles

According to the comments from the participant educatorss in their responses to the survey questionnaires and in interviews, educators' roles were shown to be a significant determinant in creating and maintaining mutual engagement among educators and how this can lead to the

formation of hybrid CoPs. Knipp (2019), who is cited in Chapter 2, Section 2.5.1, emphasises this aspect, suggesting that principals can enhance teachers' knowledge and confidence by providing opportunities for them to observe their colleagues as role models, engaging in collaborative teaching and professional development, offering constructive feedback, and fostering the development of CoPs. Specifically, the presence of leadership roles (held either by the principal or deputy principal), together with informal mentoring provided by teachers whom their peers recognise as having superior understanding of technology usage, were shown to be crucial in facilitating the exchange of knowledge among teachers. In the survey questionnaires, a total of five ($n=5$) out of 12 participant teachers (specifically, teachers A, F, G, H, and K) reported the involvement of school principals, their deputies, and/or other teachers as mentors in the use of technology for pedagogical purposes. This information can be found in Table 5.1. Out of the 12 teachers interviewed, seven ($n=7$) (B, C, D, E, F, H & L) acknowledged the significant contributions made by principals/deputies and other teachers in improving their and their colleagues' knowledge and abilities (refer to Table 5.1). The convergence of opinions among these educators is seen in the following excerpts from their comments:

Teacher B at School A:

> "Yes. For instance, if you go to someone who is more advanced than you in a particular... let's say in ICT, maybe you are not a pro then you get assistance from another teachers."

Teacher D School A:

> "Yeah, I remember. I think it was last year. Yeah, it was last year because last year I was working with Mr… And then Mr… is good in such things as WIFI. So, he was the one who was assisting me every time I have a problem even in the computer lab."

Teacher L School C:

> "I think the communication happens between the principal and the teachers. The principal shares curriculum information with the teachers."

Teachers F and H at School B, together with other teachers, as seen in Table 5.3, emphasised the crucial role that school principals play in ensuring the efficient use of technology by teachers in their classrooms. Also, Teacher L at School C, notably emphasised the crucial role that school

principals play by sharing curriculum (CK) related matters. These teachers' views are consistent with the conclusions of Hart (2023) as referenced in Chapter 2, Section 2.5.2. Hart argues that leaders who are driven and who exhibit a visionary mentality have the capacity to address the difficulties learners experience owing to restricted access to technology and their lack of technological knowledge. This capacitating of learners may be accomplished by providing teachers with encouragement and support. Furthermore, when asked about, "*How teachers acquire or enhance their technological skills and knowledge essential for teaching and learning, apart from the workshops offered by the WCED?"*, one (*n=1*) deputy principal (B) and one (*n=1*) principal (C) emphasised the important roles of teachers in their schools, teachers who are considered "knowledgeable":

Deputy principal B at School B:

> "One of us would, maybe, have more knowledge in that specific area so that person helps…"

Principal C at School C:

> "... most of the teachers were not familiar with IT but due to the fact that some of the teachers at school do have the skill. So, they transferred the skill to the educators who didn't have any knowledge in IT or technology."

Based on the comments of the participant teachers and school leaders described above, it is noteworthy that TK is identified as the most widely shared knowledge via mentoring provided by teachers regarded as role models. TK was specifically noted by four teachers (*n=4*): Teachers B and D at School A, and Teachers E and H at School B, as well as by Principal C, according to their interview replies (refer to Table 5.3 below). CK, was identified as the second kind of knowledge that is often exchanged among teachers under the guidance of informal mentors (role models). This was highlighted by Teachers C, H, and L, as seen in Table 5.3. Through this interaction teachers engaged with one other, establishing a form of mutual engagement.

knowledge shared as a result of teachers' roles								
schools	**teachers**	**TK**	**PK**	**CK**	**TPK**	**TCK**	**PCK**	**TPACK**
A	**A**							
	B	X						
	C			X				
	D	X						
B	**E**	X						
	F	X	X					
	G							
	H	X		X				
C	**I**	X	X					
	J	X	X					
	K	X	X					
	L			X				
Principals/deputy	**A**							
	B	X	X					
	C	X						

Table 5.3: Types of knowledge emerged as a result of educators' different roles

Although one (*n=1*) teacher (F) and Deputy Principal B at School B, as well as three (*n=3*) participant teachers (I, J, and K) at School C, acknowledged the involvement of the principal/deputy and/or other teachers (mentors), in their interview responses they did not explicitly state the specific type of knowledge typically shared by teachers. However, their views suggest that some teachers may acquire significant information, namely PK and TK, from teachers who are considered role models. Consequently, the formation of teachers' hybrid CoPs with the purpose of developing their TK, CK, and PK was heavily reliant on mutual engagement by means of the role of educators. The interviewee, Teacher A from School A, failed to specifically identify the kind of knowledge that teachers impart in her answers. On the other hand, in her responses to the survey questionnaire, Teacher A brought up an important point about coaching at her school. This is where more experienced teachers in terms of number of teaching years mentor and coach less experienced teachers so that both groups can learn from one another's practices and pedagogies. Similarly, Teacher F at School B indicated in the survey questionnaire that she received help from colleagues, particularly the newly appointed ones, when it comes to using technology for teaching and learning. Therefore, the findings of this current study suggest that in-service teachers and principals or deputy principals share TK, PK and CK with one another, as shown in Table 5.3 above, and consequently this leads to mutual engagement, which helped develop teachers' hybrid CoPs. This finding seems to line up with what Baya'a et al. (2019) found as described in Chapter 2, Section 2.7, that in order to get in-service teachers to incorporate technology into their lessons, in-service teachers worked with final year university students (pre-service) to create lessons that made valuable use of technology.

5.2.2. Joint enterprise

As per Mortier's (2020) definition outlined in Chapter 3, Section 3.2.1.3, joint enterprise, or domain, refers to the common goal that drives members to engage and collaborate with each other. Some further features of a joint enterprise include negotiated enterprise, shared responsibility, diverse interpretations, coordinated rhythms, and localised reactions. In the current study common goals emerged as the only sub-theme concerning joint enterprise, as emerged from the survey questionnaires and the transcribed interviews (refer to Table 5.1).

5.2.2.1. Common goal

In both the survey questionnaires and teacher interviews, a common goal emerged as a prominent reason for mutual assistance towards and within hybrid CoPs. Survey questionnaire responses from two (*n=2*) participant teachers (C and E) representing schools A and B (refer to Table 5.1) indicated that a significant number of educators in their respective schools are united by a common goal—to enhance learning through the effective use of technologies, and in ways which would create positive learning experiences for learners. Additionally, insights from interviews (refer to Table 5.1) revealed that three (*n=3*) out of the 12 participating teachers (B, C, and L) and two (*n=2*) deputy principals (A and B) identified the common goals of teachers as a crucial factor in establishing a joint enterprise:

Teacher B at School A:

> "So, when we approach certain things, like the problem of technology to teach, that's when we must come together for our learners…"

Teacher C at School A:

> "It's because the main aim of us being here is for the learner to get a quality education. And for that to happen, we need to use the best teaching strategies and resources and to work together as teachers."

Teacher L at School C:

> "… Because for me technology is a tool to enhance learning. It's only that aim."

Deputy Principal B:

> "… So, my duty is to make sure that the technology that we have is used every month, shared because we're all here for learners. So, for us to achieve what we want as a school and what the province wants, because the province has got its own vision, and the school has got its own vision. In order to meet those visions, we have to use whatever resources we have."

What stands out in the interview comments of Teachers B, C, and L, as well as those of Deputy Principals A and B, and in the survey questionnaire comments of Teachers C and E, is their

common goal of actively engaging in hybrid CoPs to acquire knowledge that will improve the learning experiences of learners. The comments made by these teachers align with the findings of Cobb et al. (2003) as outlined in Chapter 3, Section 3.2.1.3. Their study provided an example of secondary school Mathematics teachers who had the common goal of ensuring that their learners understood key mathematical concepts and performed well in math assessments. Commitment to such a goal not only motivates and encourages teachers' active participation and contribution, but also guides and gives purpose to their educational pursuits, adding importance to their efforts. Furthermore, the educators' comments in both survey questionnaires and interview responses, as evidenced in the teachers' comments above, indicate that the common knowledge communicated by means of this joint enterprise is TK (see to Table 5.4 below).

knowledge emerged as a result of teachers' common goals								
schools	**teachers**	**TK**	**PK**	**CK**	**TPK**	**TCK**	**PCK**	**TPACK**
A	**A**							
	B	X						
	C	X	X					
	D							
B	**E**							
	F							
	G							
	H							
C	**I**							
	J							
	K							
	L	X						
Principals/deputy	**A**	X	X					
	B	X	X					
	C							

Table 5.4: Types of knowledge shared a result of common goals in teachers' hybrid CoPs

The independent knowledge, known as PK, is also a product of teachers' common goal (see Table 5.4). Therefore, this common goal, affirmed and constantly renewed through teachers' strong ties, leads to the formation of teachers' joint enterprise and may eventually have a positive impact on the formation of hybrid CoPs. Thus, in this situation, joint enterprise among teachers through their common goal played a crucial role in the formation of teachers' hybrid CoPs whose aim was the enhancement of teachers' TK and PK, as shown in Table 5.4.

5.2.3. Shared repertoire

Wenger (1998) states that when community members interact with each other, they create a shared repertoire consisting of various elements such as routines, words, tools, stories, gestures, symbols, genres, actions, or concepts. These elements are developed or adopted by the community over time and become integral to its practices. The community members use these collective sets of skills and knowledge for the overall advantage of the CoP. From analysing the interview transcripts, I found that communication tools and teaching resources are significant shared repertoires in the establishment and sustaining of teachers' hybrid CoPs.

5.2.3.1. Communication tools used by teachers

CoPs can be enhanced through various technological tools, including, but not limited to, emails, Facebook chat, Twitter, video conferencing (Zoom), WhatsApp, YouTube, and learning management systems such as Blackboard Collaboration, Google Hangout, Google Classroom, Google Voice, Google Forms, and Google Meet. This array of tools is highlighted in Chapter 2, Section 2.9 by Bouhnik and Deshen (2014), Osterrieder (2013), and Singh and Awasthi (2020). In the present study, the interviews revealed that communication tools were the most shared resources among teachers in their respective schools. Teachers specified their use of communication tools such as WhatsApp, emails, and Facebook to engage with colleagues, in their frequent discussions and exchanging of ideas relating to both curriculum and non-curricular matters. For instance, in their interview responses, 11 out of 12 participant teachers (A, B, C, D, E, F, G, H, X, J, and K), along with Principal C (refer to Table 5.1), indicated their utilisation of WhatsApp, Facebook, and/or emails for communication. Notably, a subset of these teachers (A, C, I, and K, as shown in Table 5.5) specifically mentioned using these tools for sharing knowledge related to TPACK:

Teacher A at School A:

> "We use social media, we use Facebook page, we have WhatsApp groups where we share information like lesson plans, and all other things that we do."

Teacher C at School A:

> "… at the school we have WhatsApp group for colleagues, and we also have a WhatsApp group for Phase whereby we communicate about teaching resources and share videos."

Teacher I at School C:

> "Yeah. In our school we've got a WhatsApp group where we share information on curriculum matters…"

Teacher K at School C:

> "We communicate regarding the lesson that we will teach for the week. We use it to communicate the meetings. Sometimes we even hold meetings through that WhatsApp group when we don't have time."

The most notable aspect of teachers' comments is the prevalence of WhatsApp as the primary communication medium used by educators in the schools focussed on in this study. Hence, the remarks made by these teachers align with the findings of Asmara (2020) as outlined in Chapter 2, Section 2.9. She found WhatsApp to be a popular social networking platform amongst her participants, one that enables seamless communication and engagement between persons. Based on the teachers' comments in my study, the most often communicated knowledge utilising online communication platforms like WhatsApp is CK, followed by PK.

knowledge shared through communication tools								
schools	**teachers**	**TK**	**PK**	**CK**	**TPK**	**TCK**	**PCK**	**TPACK**
A	**A**			X				
	B							
	C		X	X				
	D							
B	**E**							
	F							
	G							
	H							
C	**I**			X				
	J							
	K		X	X				
	L							
Principals/deputy	**A**							
	B							
	C							

Table 5.5: Knowledge shared through communication tools

In line with the teachers' responses mentioned earlier, the examination of WhatsApp screenshots (refer to Figure 5.2) from School C revealed that teachers also exchanged knowledge pertaining to CK. This included lesson plans, learner activities, and the Google Drive internet link (TK). The latter can be considered a software technological tool that teachers can utilise to access specific resources on various ways to incorporate technology in their teaching. These resources include documents, videos, and photos. Thus, this information may be linked to TPACK. See Figure 5.2 below.

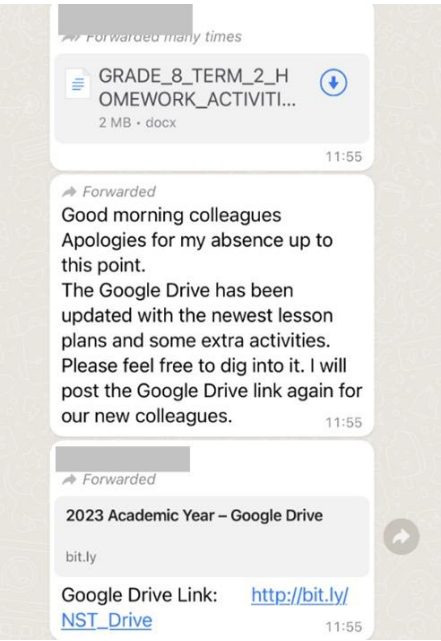

Figure 5.2: WhatsApp screenshot at School C

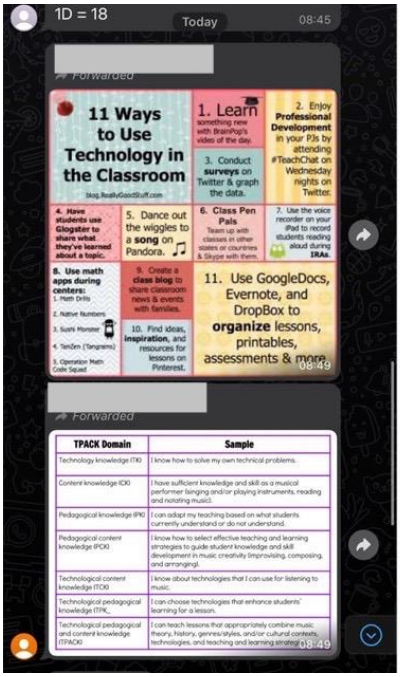

Figure 5.3: WhatsApp screenshot at School C

The information presented in Figure 5.3 shows that these participant teachers were employing WhatsApp as a shared repertoire to exchange images containing crucial information, and knowledges, including TK, CK, PK, PCK, TCK, TPK and TPACK. This observation aligns with Ajani's (2021) findings discussed in Chapter 2, Section 2.9, where the content of what was being shared in WhatsApp groups was identified as playing a significant role in facilitating these teachers' professional development. The teachers' comments and WhatsApp screenshots provide evidence that establishing and maintaining shared repertoires, particularly through teachers' WhatsApp groups, is an innovative approach that has the potential to lead to in-service teachers' sharing of information and of the various knowledges, TK, PK, CK, TPK, TCK, and TPACK. During this process hybrid CoPs may be formed. As Davis (2015) suggested in Chapter 2, Section 2.8, online meetings allow teachers to reflect on their practices, share knowledge, and communicate with their peers. This aligns with the findings of Qi and Wang (2018) mentioned in Chapter 3, Section 3.2.1.2, where the aim of those participant teachers such as documents, videos, and photos, was to support student learning in flipped classrooms via online group chats. The findings of this study and that of Qi and Wang (2018) in this regard, further indicate, through synchronous and asynchronous functions, teachers may actively engage in collaborative discussions, reflections on teaching experiences, and discussions on learner feedback and

performance. Moreover, communication tools like WhatsApp are used by teachers for the purpose of bonding and the possibility for bridging, and in this process, teachers gain important information from one another in a reciprocal way.

5.2.3.2. Teaching resources

As noted by Koehler and Mishra (2012) and Zhang and Tang (2021) in Chapter 3, Section 3.3, teaching resources encompass both traditional tools like books and chalkboards, and modern media in the form of the Internet and digital video recorders (Koehler & Mishra, 2012; Mishra & Koehler, 2006; Zhang & Tang, 2021). In the present study, survey questionnaires and interviews revealed that teaching equipment served as another shared repertoire that led to the formation of teachers' hybrid CoPs. To be more specific, teachers identified resources like MCO, CAMI, Click Foundation programmes, and Smart classrooms as teaching resources, as detailed in Chapter 2, Section 2.4. In the interviews outlined in Table 5.1 earlier, four (*n=4*) out of 12 participant teachers (C, E, H, J) and Deputy Principal B offered similar comments:

Teacher C at School A:

> "Clicks has funded us for these (computer labs) so that we as teachers can introduce programs like, besides Green Shots, like CAMI Maths... are used by most teachers we are starting those things now. Otherwise, we are using it now. But out of 100% I could say we use it 40% since the lab has not been operating for all of us. …And then in the classrooms we do have projectors and smartboards. But because of fearing the time factor when you want to include technology for content in your lesson, you just decide not include it in your lesson."

Teacher E, at School B:

> "I'm using technology every day. I love using technology. Even if you can check the records I always ask for laptops, ask for visualizers, to show my learners. And the one thing I like about technology, because our learners love technology. …In each and every class there is projectors around that I use to teach. So, they love that. That's what makes them excited, and I think in that way it catches their interest."

Deputy Principal B discussed his role in overseeing technology and learning resources at the school, including encouraging the use of MCO and CAMI software in smart classrooms. Overall,

these comments indicate that teachers are actively integrating technology into their teaching methods, with a focus on engaging, even exciting learners and enhancing their learning experiences. The likelihood exists that this shared repertoire makes teachers' formation of hybrid CoPs possible, and in the process, teachers gain important knowledge and competencies from one another. It must be noted that the participating teachers' comments in this regard also indicate that one of the reasons for teachers' sharing these resources amongst one another is the limited resources available in these schools. For example, schools may only have one or two computer laboratories, and this may force learners and teachers to share, both within the same school, and with other schools. This finding is consistent with Mahlo and Waghid (2022; 2023) as mentioned in Chapter 2, Section 2.4. Teacher E's interview responses suggested that, through their shared repertoires, teachers also acquire TK, PK and TPK from one another (see Table 5.6 below). Also worth noting is Teacher C's comment on how teachers adopted a teaching strategy (PK) from one of the teachers.

knowledge emerged through the sharing of teaching resources								
Schools	**teachers**	**TK**	**PK**	**CK**	**TPK**	**TCK**	**PCK**	**TPACK**
A	**A**							
	B							
	C	X	X	X				
	D							
B	**E**	X	X	X	X			
	F							
	G							
	H	X		X				

C	**I**							
	J	X		X				
	K							
	L							
Principals/deputy	**A**							
	B	X		X				
	C							

Table 5.6: Knowledge emerged through the sharing of teaching resources

Table 5.6 shows that, according to participant teachers' responses in interviews, among the significant information that has emerged from the shared software programmes (CAMI, Clicks Foundation, and MCO) in Western Cape, TK is the most widely shared. Then, CK (refer to Table 5.6 above) will also appear automatically since these software programmes include classroom-related content. In other words, it is essential for a teacher to have a solid grasp of the subject matter covered by a software programme before attempting to utilise it. This finding aligns with the results of a different study conducted by Lantz-Andersson et al. (2017) as previously mentioned in Chapter 3, Section 3.2.1.2. In their study they found that the teacher professional group, acting as a CoP, included collective knowledge and skills on how to improve teaching practices. This collective knowledge was found to include strategies for dealing with specific challenges in the classroom and sharing ideas on how to use teaching tools effectively. Thus, based on such studies, and on the current study, as shown in Table 5.6 above, the construction and maintenance of hybrid CoPs towards the development of these teachers' TK, CK, PK and TPK, were aided by the dimension of shared repertoire within the framework of teachers' shared teaching materials. Moreover, the presence of these teaching materials was shown to create strong ties between these teachers.

5.3. Research sub-question two

What are the driving factors and constraints around hybrid CoPs in developing these primary school teachers' TPACK?

Now that I have established the innovative approaches (dimensions) vital for the establishment and sustaining of a hybrid CoP towards developing in-service teachers' TPACK, it is also crucial to understand the driving factors and constraints associated with hybrid CoPs and their potential for developing primary school teachers' TPACK. Four themes aligned with CoP social learning theory which may act either as driving factors and/or constraints towards teachers' learning of TPACK in their hybrid CoPs emerged from the survey questionnaires, interview transcripts, teachers' meeting observations, and documents (WhatsApp screenshot) analysis (see Figure 5.4 below). These include, as described by Wenger (1998) in Chapter 3, Section 3.2.2, Community (which involves learning through a sense of belonging), practice (which involves learning through doing), meaning (which involves learning through experience), and Identity (which involves learning through becoming).

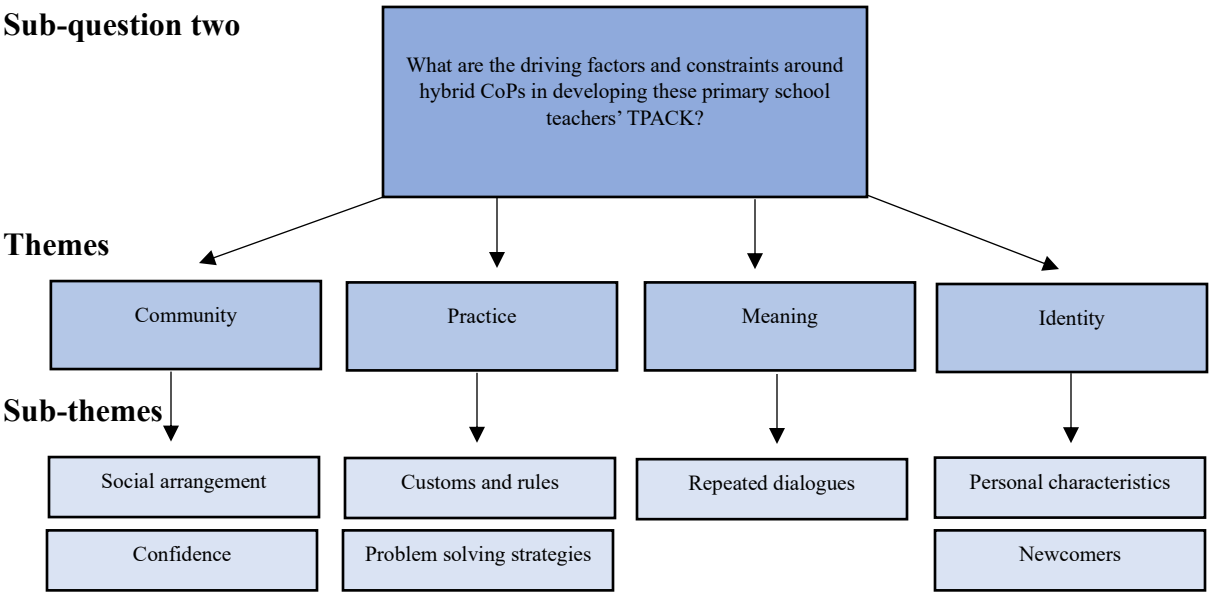

Figure 5.4: sub-question two themes

In the response to the second subsidiary question, the identified motivating factors and constraints are analysed in order to understand the influence of these factors on teachers learning processes in the context of acquiring TPACK in their hybrid CoPs. These themes and their sub-themes are summarised in Table 5.7 below. Table 5.7 only shows the data that was collected through

questionnaires and one-on-one semi-structured interviews. However, to explain and analyse in detail the factors that serve either as motivating factors and/or as constraints, data from the participants' meeting observations and document analysis (WhatsApp screenshots) were used to supplement the survey questionnaires and interviews. The symbol 'X' represents instances of teachers mentioning or implying any of the sub-themes related to the four components of CoP as explained above, and that serve as the main themes in this current study.

Schools	Teachers	Data collection tools	Community		Practice		Meaning	Identity	
			Social arrangement	Confidence	Customs and rules	Problem solving strategies	Repeated dialogue	Personal characteristics	Newcomers
A	A	Questionnaire							X
		Interview				X			
	B	Questionnaire							
		Interview			X				
	C	Questionnaire							
		Interview	X		X	X			
	D	Questionnaire							
		Interview				X	X		
B	E	Questionnaire							
		Interview				X	X	X	
	F	Questionnaire							X
		Interview		X					
	G	Questionnaire							
		Interview	X		X			X	
	H	Questionnaire							
		Interview							X
C	I	Questionnaire							
		Interview						X	
	J	Questionnaire							
		Interview		X				X	
	K	Questionnaire							
		Interview		X			X		X

	L	Questionnaire							
		Interview	X	X					
Principal/deputy	A	Interview							X
	B	Interview							X
	C	Interview							

Table 5.7: Motivating factors and constraints towards TPACK development in hybrid CoPs.

5.3.1. Community (learning through a sense of belonging)

Some participants specifically addressed the theme of community in their interviews. Wenger (1998), cited in Chapter 3, Section 3.2.2.3, elucidated how distinct communities are formed through the shared experience of a sense of belonging among the members of a community. In this current study, two important sub-themes emerged from teachers' interview responses. These included social arrangements and teachers' confidence. The theme of community, then, was described through these sub-themes.

5.3.1.1. Social arrangement

Wenger's (1998) definition of this is cited in section 3.2.2.3 of Chapter 3. He describes a community as a social arrangement distinguished by the recognition of the competency of its members in participation and the delineation of their initiatives. Teachers participating in my study advocated for the ICT committees to serve as a social structure within their hybrid CoPs. They regarded their respective CoPs as vital support systems that could be accessed by those teachers in need of assistance with technology integration in their classrooms. Three (*n=3*) of the 12 participant teachers (C, G, and L) commented in their interview responses on the supportive functions of their respective ICT committees:

Teacher C at School A

> "I think at the school, like in the ICT committee... we do have people who have knowledge in connection with technology.

Teacher G at School B:

> "... And there also those who are in the ICT Committee that I can also go to whenever I need information."

Teacher C and A, from Schools A and B respectively, offered comments indicating that the presence of school-based ICT committees (as shown in Table 5.7), which include the school management team (SMT) and teachers, contributed to teachers' feeling a sense of belonging in their hybrid CoPs. The goal of these committees, as stated by Teacher C and G, is to provide assistance to teachers in matters related to various technologies. Thus, according to these

teachers' comments, this particular aspect (component) of community may motivate teachers to enhance their TK development in their hybrid CoPs. This discovery aligns with the conclusions of Vanderlinde et al. (2011), who found that, for educators to utilise digital teaching effectively, it is essential to build support systems that empower them to enhance their technological skill and confidence. An examination of WhatsApp screenshots (see Figures 5.5 and 5.6 below) demonstrates the role of ICT committees in hybrid CoPs.

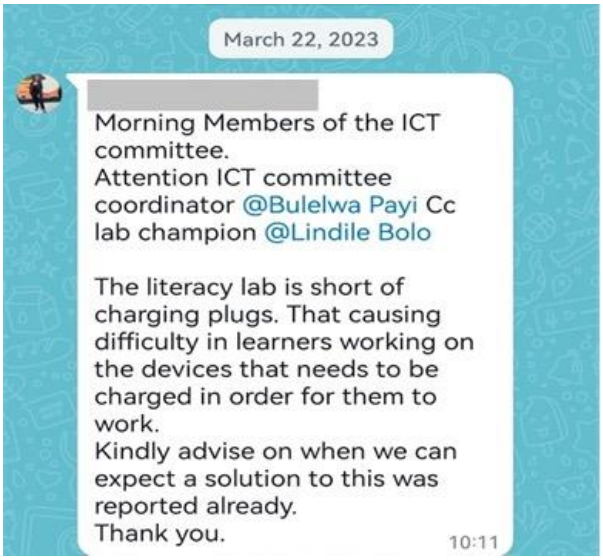

Figure 5.5: WhatsApp screenshot at School A

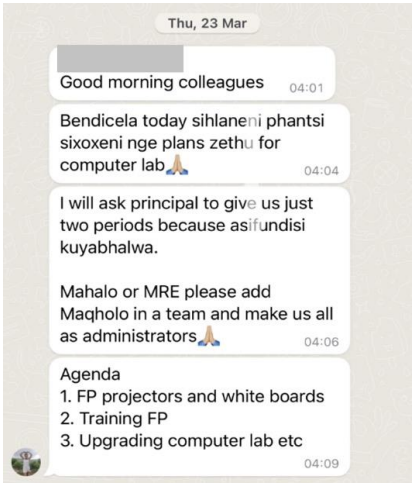

Figure 5.6: WhatsApp screenshot at School C

Figure 5.5 depicts a conversation among the members of the ICT committee on technology equipment, including charging plugs for tablets and laptops. This discussion is pertinent to in-service teachers' acquiring of TK. Figure 5.6 displays a notice written in Isixhosa, which conveys a request for a meeting to discuss the arrangements for a computer laboratory. The teacher's message has an agenda that specifically references the use of technology equipment and the need for teacher training in technology usage. Given that Figure 5.6 does not clearly indicate the specific type of knowledge teachers may be sharing during this planned training, it can be reasonably assumed that they are likely to acquire TK in the course of the training due to the accepted practice of the involvement of technologies for curriculum delivery. WhatsApp screenshots from these schools demonstrate the proactive involvement of school-based ICT committees, despite the possibility of the absence of an established ICT policy. Therefore, as indicated by teachers' comments and the WhatsApp screenshot analysis, the presence of these committees in schools and hybrid CoPs can be said to strengthen teachers' ties and to motivates them to actively pursue the development and improvement of their TK.

5.3.1.2. Teachers' confidence

Understanding the learning process that takes place in a CoP requires looking at the different modes of belonging, such as engagement, imagination, and alignment. These modes may help community members develop confidence, as pointed out by Wenger (1998; 2010) in Chapter 3, Section 3.2.2.3. In Michalski et al.'s (2020) study, as specifically mentioned in chapter 3, Section 3.2.2.3, community participation and active engagement were found to have a beneficial effect on the quality of life of people in general This beneficial effect may be related to the improvement of their feeling of identity and confidence, in contrast to adverse experiences of anonymity and seclusion. In the interviews conducted for the present study, four (*n=4*) out of 12 participant teachers (F, J, K, and L) all reported unpleasant experiences resulting from isolation, which could stem from a lack of confidence in their use of technology for educational objectives. This perspective is evident in the comments provided by a few chosen teachers:

Teacher F at School B:

> "Some of colleagues don't have confidence to use technology, they do ask help from each other but some of them don't. Because they feel like if they are asking, and going to someone, it might be taken as if they know nothing."

Teacher K at School C:

> "… Because some of us don't really use technology that much because there is no confidence. But sometimes we really want to do it. We even forget how to do that thing we were taught…"

Teacher L at School C:

> "I think it is because teachers lack confidence. Because maybe if you go and ask around for some advice then maybe you will believe they'll undermine you. I think it's because of that."

There did not seem to be a feeling of community among the teachers in the hybrid CoPs of these two schools (B and C), which is concerning since, lacking a sense of belonging, teachers could be hesitant or ashamed to seek help from their peers when it comes to incorporating technology into their lessons. Thus, these remarks can be associated with teachers' lack of TK, TPK, TCK, and TPACK since they would not feel comfortable or confident using technology in their classrooms. From the remarks of these teachers there did not seem to be much of a sense of community in their CoPs, or possibly in their schools. In this respect, the teachers' remarks are opposite to those from the results of Patton and Parker (2017), as cited in Chapter 3, Section 3.2.2.3. The authors stressed that when colleagues were fully engaged in a collective project, this reduced their feelings of isolation, and a heightened sense of confidence emerged, which then allowed for the recognition of potential amongst the members of the CoP. In this context, while community can be a driving force in some of the schools studied in this current study, it, or lack of it, can also be a barrier to teachers' professional practice knowledge such as TK, TPK, TCK, and TPACK growth in their schools if they experience feelings of isolation and lack a strong sense of belonging (see Table 5.7). This kind of negative feeling amongst some teachers may have been caused by the non-practice of bonding among teachers.

5.3.2. Teachers' practice (learning through doing)

Some participants addressed the theme of practice. As stated by Lave and Wenger (1991) in Chapter 3, Section 3.2.2.1, engaging in CoP involves actively participating in the community's socialisation process. This process allows individuals to gradually adopt the community's language, customs, and strategies. In this current study, emerging sub-themes included customs and rules practiced by teachers, and problem-solving strategies adopted by teachers.

5.3.2.1. Customs and rules enforced to teachers

As described by Winiecki (2001: 148) in Chapter 2, Section 2.5.1, informal institutions, often referred to as informal rules, include a wide variety of elements such as traditions, customs based on traditions, religious and ideological beliefs, and enforced norms of behaviour. Four (*n=4*) out of a total of 12 participant teachers (B, C, G and I) highlighted the customs/rules of the schools as a limitation to the acquisition and use of technology for teaching and learning in their schools, as seen in Table 5.7 above. In the interviews, when asked the question, "*What factors could work against your using technology in your classroom?",* These teachers responded:

Teacher B at School A:

> "It's that sometimes when you arrive at a certain school, you found that it has got its own culture. And then you don't want to appear as a know-it-all person."

Teacher G at School B:

> "… since we have projectors, I do not have an excuse not to use it. Unless I was late in the morning, and I can't get a laptop. Because here at the school the laptop time limited. After certain times you can't borrow a laptop. Because according to our management you are late."

Teacher I at School C:

> "…according to principal we must share… so you might not get a chance to use it."

Teacher B at School A brought up the fact that different schools have different cultures and that some of them may not be competent or motivated users of technology. As a result, in her current

school, she is hesitant to provide suggestions for improvement for fear of seeming to be trying to change the culture of that school. In addition, she wants to avoid coming to be seen as too knowledgeable, and this tentativeness might cause her to avoid using such technology as is accessible in his classes. The remarks made by Teacher G at School B, and by Teacher I at School C, indicate that the school management has informal/unspoken rules in place as an entrenched practice, one of which is that teachers may not be granted access to laptops after a certain period has passed if they seek them. These results suggest that the teachers at that school may have low TK, TPK, TCK, and TPACK as they are not being given opportunities to employ technology in their pedagogical practices. Such teachers are missing out on opportunities to incorporate technology into their lessons, according to Teacher G's statement concerning School B. The findings of Dube et al. (2018) described in Chapter 2, Section 2.5.1, corroborate the opinions of these teachers, who voiced their discontent with the rules and practices instituted by principals and other school officials in a number of South African primary schools. Teachers' discontent with customs/rules, and their lack of power or agency to resist these, restricts, their pedagogical use of technology in their classrooms. Thus, in this regard, entrenched practice as a dimension of a CoP may hinder in-service teachers from acquiring TK, TPK, TCK and TPACK from colleagues in their hybrid CoPs.

5.3.2.1. Teachers' problem-solving strategies

Holland (2018), in Chapter 3, Section 3.2.2.1, defines a healthy CoP as one whose members engage in collaborative activities to jointly build problem-solving strategies and successfully handle practice-related issues. In the current study the emergence of the participating teachers' problem-solving strategies served as a second sub-theme, one that was seen in terms of contributing to the improvement of their teaching practice. These teachers implied that, through bonding, they sometimes engaged in conversations with their colleagues to address issues pertaining to the use of technology for educational purposes. Responding to the question, "*Do teachers work together here at the school?",* Four (*n=4*) out of 12 participant teachers (A, C, D, and F) (as seen in Table 5.7) specifically commented on problem-solving strategies, as can be seen in the selected teacher's comment:

Teacher A at School A:

> "We do. We talk a lot about those strategies to help the learners. Even those strategies that will be helpful to us as well. Because if you notice most teachers that are in the schools are the teachers that got their education a long time ago. And it's imperative for us to talk about these things. They don't have any idea and are not familiar with many technologically related things. So, we have an obligation to talk and share the ways as to how a person can have technological skills."

Teachers A, C, and F explicitly indicated that they engaged in discussions with colleagues to address issues and find solutions related to the use of technology in the context of teaching and learning. Their responses suggest that the valuable information that these teachers learn from their technology-focused meetings is TK. In addition, Teacher A elaborated by adding that they sometimes engaged in discussions and attempted to resolve issues pertaining to their pedagogical methodologies. Therefore, according to the statement made by Teacher A, PK is a crucial set of knowledge that teachers may learn by means of problem-solving processes in their schools. This teacher (A) also said that their primary interactions were with all educators, since some teachers are not well-versed in the integration of technology in their teaching due to their graduation from teacher training institutions many years ago. Teacher D argued that, while it might be difficult for teachers to come to an agreement on a particular issue, they ultimately managed to achieve a consensus. Regarding problem-solving strategies, teachers' comments align with the research conducted by Holland (2018) as well as by Mahlo and Waghid (2023), as described in section 3.2.2.1. These researchers, from the findings of their respective studies argued that a strong CoP is characterised by the cultivation of collaborative practices among its members. This enables them to collectively generate problem-solving strategies and effectively tackle issues related to their professional field. In this current study, the findings clearly indicate that, by sharing and using problem-solving strategies, teachers may learn TK and PK from their peers in hybrid CoPs, making this a motivating factor for their professional growth. Also, the finding in this regard indicates that there exists a strong bonding relationship between these teachers.

5.3.3. Teachers' meanings (learning through experience)

Wenger (1999: 52) as cited in Chapter 3, Section 3.2.2.2, explains how people's participation in an activity can display patterns, and how it is the formation of these patterns that gives them a feeling of purpose. Also, Krzywoszynska (2019), as cited in Section 3.2.2.2 of Chapter 3, notes that a

sense of meaning primarily helps with the internal growth of a CoP, which in turn helps with the continual learning of CoP members. One subtheme that emerged from the interview transcripts and teachers' meeting observations was people's interpretations of meaning through instances of repeated dialogue.

5.3.3.1. Repeated dialogues

In the context of a school, members of the teaching staff may be intimately familiar with their counterparts, yet they continue to engage in repeated dialogues. While everything they say and do may allude to previous actions, it always results in a whole new scenario, set of impressions, and experience. Wenger (1999) describes this tendency in Chapter 3, Section 3.2.2.2, and it explains how people's meaning-making tends to either expand, divert, reject, reinterpret, alter, or affirm the meaning-history to which they belong. In response to the interview question, "*What platforms does the school use to communicate important matters with staff?",* three (*n=3*) of the 12 participant teachers (D, E and K) (as seen in Table 5.7) at the three (*n=3*) schools (A, B, and C) respectively mentioned that before they start the day they use scheduled brief meetings on certain days of the week to talk about issues related to their practice:

Teacher D at School A:

> "When there is an information that the principal needs to share, there are briefings that we hold on Tuesdays and Thursdays. The information is shared during these briefings. Then if it's something urgent like on a Monday, there is a WhatsApp group for schoolteachers. So, the principal or deputy shares the information there when he can't meet the people face-to-face."

Teacher E, at School B:

> "… So even if we are in the staff room for meetings and briefings and stuff, I always go there first and then give them briefings before the management comes and do briefings (both laughing). So yeah, I'm connected to all the teachers."

Teacher K at School C:

> "… Sometimes we even hold meetings through that WhatsApp group when we don't have time."

This practice of continuous learning and repeated dialogue was also mentioned by Deputy Principal A at School A:

> "In terms of other things, we use briefings.... Most of the things that we communicate in briefings are curriculum related."

The briefings (morning short meetings) before the start of the day at each of the three (*n=3*) schools, makes for a convenient space for teachers to generate and negotiate meanings as these meetings are constantly and repeatedly held on certain days of the week at these schools. Thus, the likelihood exists that whatever was discussed on past brief meetings may be discussed again in the following meetings, but possibly with additional issues or details being added. Based on the teachers' comments above the person chairing the meeting (normally the principal) shares and/or reminds teachers about the same things which may be related to teachers' practice. Teachers are also allowed to raise concerns or comment about their practice in these morning brief meetings. This was also evident in the observation of these brief meetings at School C, during the second observation on the 19th of April 2023. At this school the principal talked mostly about the same things as she had in the previous brief meeting on the 17th of April 2023. These included the effective use of teaching and learning time by teachers and teachers' ground duties. She also reiterated her encouragement of teachers to make use of computer labs (TK and TPK). Moreover, what also stood out from these brief meetings was that the language the teachers used to communicate with each other at the two (*n=2*) schools (A and C) as observed, was Isixhosa, which is the common language spoken in a large number of households and schools in the Western Cape. The findings from these observations are consistent with what Wenger (1999) described in Chapter 3, Section 3.2.2.2 as the concept of negotiation of meaning. This concept encompasses various aspects, such as language usage, the attainment of consensus, and the execution of a task that necessitates sustained attention and modifications. The interview response of teacher K at School C indicates that teachers' meanings can also be negotiated through the online meetings on platforms like WhatsApp. Thus, Teacher K's comment is in line with the findings of Magnusson and Godhe (2019), Chapter 3, Section 3.2.2.2, who argue that utilisation of communication

technology has not only facilitated the amalgamation of resources but has also simplified the process of creating meaning through diverse modalities and media. The teachers' repeated dialogues served as evidence that teachers' ties to one another are strong, and, moreover, these were serving as a motivating factor towards these teachers' acquisition of TK and TPK in their hybrid CoPs.

5.3.4. Teachers' identity (learning through becoming)

As per Wenger's (1998) assertion in Chapter 3, Section 3.2.2.4, the concept of identity can be characterised as a process of acquiring knowledge through the act of becoming, and the term "identity" can be utilised to enable a sociological analysis of an individual's position within a group. In other words, identity involves learning through becoming. Teacher participants described their and/or other teachers' identity as members within a hybrid CoP and as a collective, through two (*n=2*) emerging sub-themes. The first sub-theme was described by four (*n=4*) out of 12 participant teachers, and they described the resistance to change to the new ways of teaching by older teachers as a personal characteristic that was preventing certain teachers from becoming competent technology users for pedagogical purposes. Novice/new teachers (newcomers) who had recently started working professionally as teachers is a second sub-theme advocated by two (*n=2*) teachers and two (*n=2*) deputy principals.

5.3.4.1. Teachers' personal characteristics and traits

In the learning process, in addition to acquiring new knowledge, one is also developing and honing one's own personality characteristics, as described by Wenger (1998) in Section 3.2.2.4 of Chapter 3. For reasons already mentioned in Section 2.5.4 of Chapter 2, Mathipa and Mukhari (2014) maintain that external or institutional limitations are not the only explanation for the underutilisation of technology in the classroom. Teachers' resistance to change, and general distaste for technology are examples of teacher-level obstacles to their acquiring technological knowledge and skills. Resistance to adapting to new ways of teaching particularly by older teachers as described by four (*n=4*) teachers E, G, I and J (as seen in Table 5.7) is a negative personal characteristic that, for certain teachers may act as a constraint in their becoming fully competent in the use of technology for teaching and learning. Below, are comments from the teachers giving

their perspective on, "*Why certain teachers are resistant to integrating technology in their teaching?":*

Teacher E at School B:

> "I think young teachers believe in the use of technology, but the older teachers feels like it's a waste of time for them. Because I once asked one of our teachers 'why are you so against working with computers and stuff'? He said 'I 'm too old to learn new things. It's only too late for me. It's good for you guys because you're still young'. So, I think it goes with the age in our school."

Teacher I at School C:

> "Here at school, we've got a very big gap between teachers. We've got young teachers and we've got older teachers. So, the older teachers feel challenged when it comes to technology. They don't feel comfortable regarding technology. The young ones have no problem in dealing with technology… The older teachers are reluctant to come down to the young teachers. And the young teachers don't want to go to the older teachers to teach them about technology."

As stated in Teacher E's reply, some teachers believe that their age hinders their ability to acquire technological skills for pedagogical purposes, rendering it unnecessary for them to learn these. Consequently, when they plan to use technology in their teaching, they have a sense of inadequacy and prefer not to seek help from the so-called "younger teachers," as mentioned in Teacher I's remark. The teachers' statements align with the conclusions drawn by Umugiraneza et al. (2018) in Chapter 2, Section 2.5.4. These authors contend that there is a potential for teachers to show hesitancy in integrating technology into their teaching techniques as they become older. Thus, the attitude of not wanting to adapt to new ways of teaching, as is the case with teaching with technology, may be seen as a constraint operating against teachers' willingness to acquire TK, TPK, TCK and TPACK in their hybrid CoPs.

5.3.4.2. Newcomers

Phillips (2014), as cited in Chapter 3, Section 3.2.2.4, defines a CoP as a dynamic environment that provides newcomers with access to expertise and an opportunity to actively participate. This participation allows them to integrate their newly acquired knowledge into their sense of identity as engaged members of the community. In accordance with Cuddapah and Clayton (2011), referenced in Chapter 2, Section 2.6, those who have been in the community for a long time are regarded as core players, whereas newcomers who are still learning about the community are termed peripheral participants. The interviewed teachers expressed their gratitude for the accessible assistance provided to them as novice teachers by senior teachers to enhance their professional growth. For example, in response to the interview question, *"Apart from the workshops conducted by the district, how do or did you acquire your technological skills for teaching and learning?",* Two (*n=2*) teachers (H and K) of the 12 participant teachers responded that, since they are new (less than a year) at their schools, they sometimes get to be assisted by other teachers who possess more teaching experience in terms of number of years. This finding is derived from participants interview responses:

Teacher H at School B:

> "… I signed a contract here last year and I was fresh from university. So, I wasn't sure as to what is expected of me as a teacher and all that. So, the deputy principal organised mentorship (through another teacher) for me so that I can be more awake as far as the job is concerned. Otherwise, they were under no obligation for my mentorship."

Teacher K at School C:

> "I have a relationship with the teachers in my Grade. Because we always work together. Even if there is something I don't understand because I'm still new in the teaching industry. I'm not perfect and I'm still learning everyday… Because they understand that you're still new in this industry and I won't know everything because I'm coming from the varsity."

Similar comments were made by Deputy Principals of two of the schools:

Deputy Principal A at School A

> "… like recently, there were some who spoke out that they would like to use those (the word sounds like "e-Ps" but indistinct). And they are new teachers anyway; they just started, including using the MCO. So, this scope, like I am available and there also others who are familiar with it. So, we normally arrange internal workshops and hold a session. The aim is to equip teachers with all the skills not just technology but the content and how to deliver the lesson using a certain tool."

Deputy Principal B at School B:

> "… So, we also have new teachers when… (inaudible), so we normally do is to braai just to get everyone on board. To get everyone on board we run our workshops."

As per the interview answer from Deputy Principal A, new entrant teachers may have the opportunity to learn TPACK from the more seasoned teachers. In this regard, new teachers can learn by becoming full competent members of the community when they can effectively use technology for content delivery. This finding aligns with the research conducted by Schlager and Fusco (2003), who argued that newcomers gain access to a community's professional knowledge tools and social norms by actively participating in authentic activities alongside experienced members. However, in the context of newcomers, the participants' views mentioned earlier do not align with the replies provided by teachers in the survey questionnaires. For instance, in the survey questionnaires, Teachers A and F at School A and B, respectively, acknowledged the valuable support of experienced teachers regarding teaching strategies. However, when it comes to incorporating technology into their teaching, Teacher F in her response to the survey questionnaire question, "*Apart from workshops organised and conducted by WCED, how did you acquire your technological skills for teaching and learning",* commented that they primarily learn such skills/acquire new knowledge from newly hired or inexperienced teachers in terms of number of teaching years, and this helps to improve their sense of belonging. This comment may provide an indication that the presence of newcomer teachers in this school (B) may provide the opportunities for other teachers to learn TK from these newcomers. Moreover, what is consistent about these two comments (Teacher A and F) is the fact that the ties between older generation teachers and young teachers are clearly strong as a result of bonding mainly for knowledge sharing.

Thus, a sense of belonging (identity) may be seen as a driving or motivating factor for teachers' TK growth in their hybrid CoPs.

5.4. Research sub-question three

What was the nature and degree of the strengths of these in-service teachers' relationships in their hybrid CoPs while they were in the process of learning TPACK from one another during the recent COVID-19 pandemic?

Now that I have explored the driving factors and constraints involved in the establishment and workings of hybrid CoPs in the course of teachers acquiring TPACK from one another, it is also vital to understand the tie strength between teachers while they are in the process of acquiring TPACK in their hybrid CoPs. Therefore, in response to the third sub-question, the identified types of ties are analysed in order to understand the extent and strength of these social ties' influences on the teachers' acquisition and development of TPACK in their hybrid CoPs during the COVID-19 pandemic lockdown period. Assessing the correlation between stronger and weaker ties and their influence on knowledge transfer might provide useful insights into the dynamics of social interactions and their effects on teachers' learning outcomes in the context of TPACK growth during times of crisis. Bonding and Bridging (see Figure 5.7) are the two themes that emerged in this study aligned with the Strong and Weak Tie Theory (Granovetter, 1973) as cited in Chapter 3, Section 3.3.

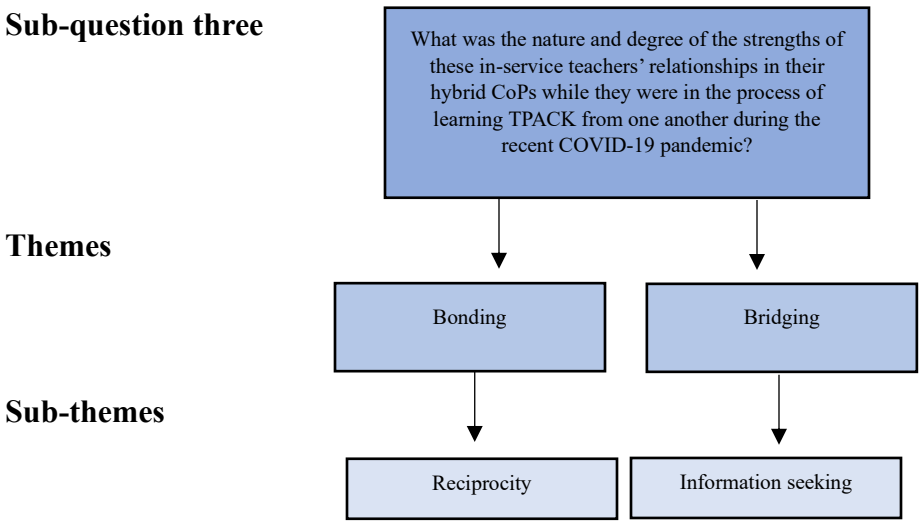

Figure 5.7: Sub-question three themes

5.4.1. Bonding

As previously cited in Chapter 3, Section 3.3, Lin (2001) explained that strong ties are linked to bonding social capital, which refers to intimate relationships within one's own peer group (CoP). Proximity of individuals to each other in a particular context increases the likelihood of forming strong bonds based on solidarity, reciprocity, familiarity, and trust, as stated in Chapter 3, Section 3.3 by Coleman (1994) and Granovetter (1973). These definitions suggests that, in the context of a CoP, individuals acquire knowledge and assistance by fostering close relationships with their peers inside their own CoPs. Reciprocity, a sub-theme, was emphasised by certain participant teachers in this research.

5.4.1.1. Reciprocity

According to Cherry (2023) as cited in Chapter 3, Section 3.3, reciprocity occurs when people engage in joint efforts to exchange and share resources. According to the findings of my research, the participant teachers often engaged in the reciprocal act of sharing and exchanging knowledge with one another throughout the COVID-19 epidemic lockdown, as shown by their interview data. During the lockdown period, as mandated by the Disaster Management Act of 2002, schools across the country were placed under lockdown in accordance with the education emergency guidelines outlined by Landa et al. (2021), cited in Chapter 2, Section 2.10. This required both teachers and learners to refrain from entering school premises. In response to the interview question, "*How did you manage to keep up with the new demands related to your work, more especially your teaching during the COVID-19 pandemic?",* among the 12 teachers interviewed, four (*n=4*) teachers (C, D, K, and L) said that they communicated information on curriculum matters with their colleagues through WhatsApp during the school closure, and during learners' rotating attendance during lockdown levels 4 and 5:

Teacher C at School A:

> "Here were open and we had half of the learners coming to school… We shared information with colleagues whom I was sharing the subjects with."

Teacher D at School A:

> "I think the information that we were sharing during Covid 19 was mostly about personal matters and content subject for learners…"

Teacher K at School C:

> "Yes, I was always communicating especially with my Grade colleagues. If there's anything new that has been communicated, they just let me know even if they just send me a WhatsApp. We were communicating regarding the lesson that we will give parents, regarding the work that we will give them for their children. So yeah, we were communicating and sharing ideas."

Teacher L School C:

> "Even though we were in lockdown we still had to share information with the learners... So, we needed to communicate as teachers in order for us to know which work we share with the learners."

These teachers' comments suggest that, since they were instructed by the South African Government (SAG) to avoid going to schools, they had to find alternative methods to deliver the curriculum to learners given the unfeasibility of face-to-face education during the COVID-19 pandemic school shutdown. This finding is consistent with the findings of Tadesse and Muluye (2020) as described in chapter 2, section 2.10. According to their comments, four (*n=4*) out of 12 teachers confirmed and indicated that the predominant information they shared during the lockdown and partial school attendance was linked to CK. For instance, teachers were required to provide the educational content to be covered and to transmit it to learners either via WhatsApp or another means of contact with parents. This discovery aligns with the research conducted by Yang et al. (2020), as reported in chapter 2, Section 2.10, which revealed that online communication enables educators to engage in discussions, assess new protocols for transitioning to online classrooms, and exchange insights into their experiences with teaching and learning in virtual settings.

Teacher D added to this response, reporting that, in addition to "content subject for learners", they communicated information about their personal affairs. This finding aligns with that of Hargreaves (2021) regarding the fundamental concepts outlined in Chapter 2, Section 2.10. This

emphasises the significance of strong social ties and emotional support given by teachers to their colleagues to assist them to carry out their duties effectively. Hargreaves (2021) argues that teachers derive advantages from the unlimited exchange of ideas and knowledge within CoPs. Uninterrupted and effective teaching is dependent on the social and ethical support of colleagues inside the school premises. Thus, in accordance with Granovetter's (1985) assertion, the results from both his study and the current study indicate that strong ties provide several benefits, such as being cost-effective and offering more reliable information due to their greater depth, specificity, and accuracy. It may be inferred that in some schools, such as those used as samples in this study, teachers were able to establish strong ties and relationships through emotional support, and that during this process teachers shared CK inside their hybrid CoPs during the COVID-19 pandemic lockdown.

5.4.2. Bridging

Lin (2001) defines bridging as the ties between individuals belonging to different social groupings, as explained in Chapter 3, Section 3.3. When people from different CoPs (schools) collaborate to share information, ideas, and physical resources, they establish connections characterised by weak bonds. Thus, Granovetter (1973), as mentioned in Chapter 3, Section 3.3, argues that weak relationships are essential in enabling connections across different social groupings and acting as a helpful "bridging" mechanism. In this current study, the process of bridging was explained by means of the sub-theme of information seeking.

5.4.2.1. Information seeking

Weak ties are characterised by their reliance on information exchange and are often seen as characterising temporary and shallow relationships that arise between persons from different origins and subcultures, as described by Lin (2001) in Chapter 3, Section 3.3. Within this current research, the act of teachers' obtaining information from other schools surfaced as a significant sub-theme, since some teachers exhibit a tendency to seek assistance from teachers who are not affiliated with their own schools. When addressing the interview question, *"How did you manage to keep up with the new demands related to your work, more especially your teaching, during the COVID-19 pandemic?",* four (*n=4*) teachers (A, D, K and L) out of 12 indicated in their responses that they sometimes communicated with teachers from other schools regarding information related

to their teaching practices at the time of lockdown and rotational attendance of learners due to the COVID-19 pandemic:

Teacher A at School A:

> "…I would also ask for help from friends from another school. Maybe ask if they can share learners notes and activities with me since we taught the same subject and grade."

Teacher D at School A:

> "…Also, we shared information with other schools..."

Teacher K at School C:

> "So yeah, we were communicating and sharing ideas. Especially that the government required us not to cover the whole curriculum since learners came only for two/three days a week in schools. We would also ask from other schools how they implement new strategies then."

Teacher L at School C:

> "Also, during Covid because of the lockdown, I often asked for information from my friends at other school. They also asked for advice from me like how to deliver the work to learners."

The aforementioned remarks made by these teachers suggest that, during the shutdown of schools during COVID-19, educators from and across various schools engaged in collaboration by exchanging information, which in this case was information about CK and PK. This discovery aligns with the results of Hargreaves (2021) about the teaching practice as described in Chapter 2, Section 2.10. Through this bridging, teachers were, according to Erickson (2004) and Lin (2001), as discussed in Chapter 3, Section 3.3, establishing weak ties which would enable individuals to access a larger number of people and resources outside their community. It is noteworthy that in the remarks of Teachers A and L, they explicitly request help from teachers at other schools with whom they are already acquainted, and with whom they have established ties. The findings in this regard reflect the existence of weak ties between educators from different schools and indicate that

collaboration is not limited to one group but can include connections across diverse social groups. This kind of connection serves as a beneficial tool for bridging, as stated by Granovetter (1973) in Chapter 3.

5.5. Chapter summary

This chapter provided an overview of the results of my research into the influence of hybrid CoPs on the development of TPACK among a sample of primary school in-service teachers in a historically marginalised region of Khayelitsha in the Western Cape province of South Africa. The data revealed that the participant teachers were engaging in the formation of hybrid CoPs at their respective schools and were unintentionally and intentionally employing three ($n=3$) innovative approaches. During this process they were found to be learning important knowledge from one another related to TPACK. These innovative approaches involved, firstly, mutual engagement, facilitated by the practice of teamwork on the part of these educators and by the various roles undertaken by the school principals, deputy principals, and other teachers, all of which facilitation and support had led to the formation of hybrid CoPs. During this process these educators were acquiring TK, PK, and CK. Joint enterprise was another approach which had led to the formation of these hybrid CoPs while in the course of the development of these CoPs the participant educators were acquiring from one another important knowledge such as TK and PK; shared repertoire, enabled by the accessibility and user-friendly nature of communication tools, specifically the WhatsApp group feature, as well as the availability of teaching resources (media) had led to the formation of these hybrid CoPs, and in the process of developing their skills in using these tools these teachers were also acquiring a wide range of knowledges and skills: TK, CK, PK, PCK, TCK, TPK and TPACK. The results also provided insight into the factors that had motivated and/or hindered these teachers from learning TPACK in their hybrid CoPs. The sense of community through available structures, such as ICT committees inside the selected schools appeared to be a motivating factor for these in-service teachers to acquire TK in their hybrid CoPs. However, on the other hand, at times this sense of community, or lack of it on the part of individual members served as a constraint in their acquisition of TK, TPK, TCK and TPACK. This was due to the feeling of isolation some teachers had, stemming from not having a strong sense of belonging. Their sense of entrenched school practices arising from teachers' dissatisfaction with ICT school rules and entrenched customs also served as a constraint to these teachers developing TPACK in

their hybrid CoPs. However, practice in problem-solving strategies within their hybrid CoPs was instrumental in driving their acquisition of knowledge, including both TK and PK. The teachers' sense of meanings served as a motivating factor, and this was made possible by means of the teachers' repeated dialogues inside their hybrid CoPs; this led to these teachers' development of TK and TPK. Their formation of identity served as a constraint to the possibility of developing their TK, TPK, TCK and TPACK in their hybrid CoPs. This was engendered by certain teachers' personal characteristics and traits which caused them to resist change. Identity also served as a driving factor for certain individual in-service teachers and collectively to share TK, and this was made possible by newcomers, new entrant teachers who tended to be regarded by other teachers as more knowledgeable when it comes to using technology to deliver lessons. Additionally, the data indicated that, throughout the COVID-19 pandemic lockdown in South Africa, teachers within hybrid CoPs formed both strong and weak ties in the process of their acquiring TPACK from each other. Teachers' bonding at the same school resulted in reciprocity, and this was an indication of strong ties between teachers in the same school. On the other hand, a bridging process during this time resulted in teachers exchanging knowledge with teachers from different schools, and the result of this is an indication of the development of weak ties. Figure 5.8 presented below offers an overview of the research and indicates the current status of its progress. In Chapter 6 I provide an in-depth discussion of the findings and their implications.

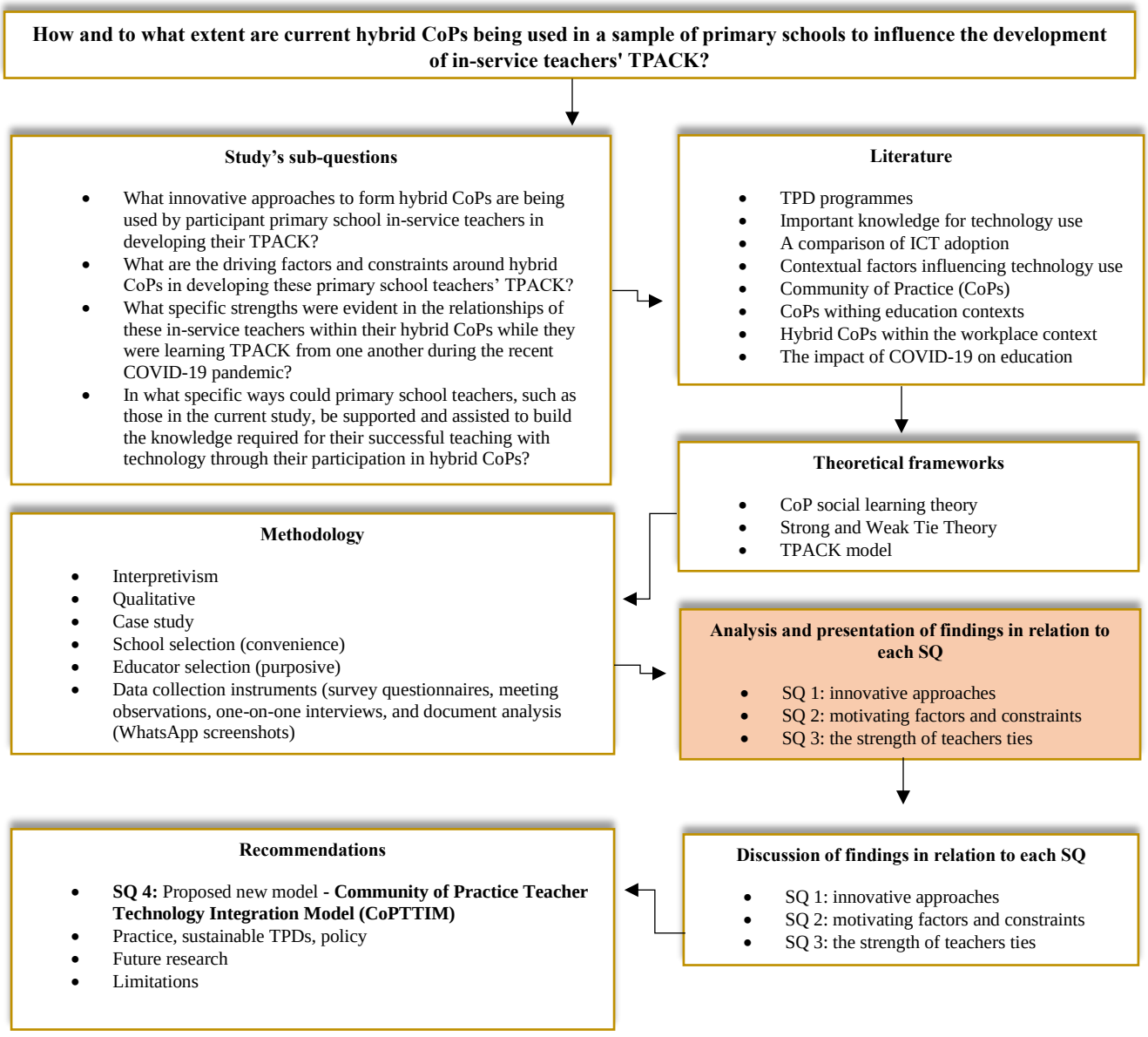

Figure 5.8: An overview of the research and indicating the current status of its progress

CHAPTER 6: DISCUSSION OF FINDINGS

6.1. Introduction

The previous chapter presented the findings and an analysis of these in relation to the main research question formulated in Chapter 1: *How and to what extent are current hybrid CoPs being used in a sample of primary schools to influence the development of in-service teachers' TPACK?*

In response to this main research question, this study discovered that a group of in-service primary school teachers had adapted certain innovative approaches to form hybrid CoPs with the purpose of developing their TPACK. These innovative approaches included mutual engagement, fostered by teamwork and diverse educators' roles; joint enterprise, fostered by the establishment of common goals; and shared repertoire enabled by the use of communication tools and the sharing of teaching resources. In addition, yielded several insights regarding factors either motivating teachers to, or depriving them from acquiring TPACK in their hybrid CoPs. A sense of community, facilitated by structures like ICT committees within schools, motivated teachers to engage in hybrid CoPs. However, this sense of community also acted as a constraint due to feelings of isolation and a lack of confidence among some teachers. Concerning practice, teachers' dissatisfaction with certain school customs and rules related to ICT use hindered these teachers from acquiring TPACK in meaningful and effective ways for their teaching. Yet, when it came to problem-solving strategies, practice served as a driving factor. Repeated dialogues within hybrid CoPs motivated teachers' development of TPACK by incrementally creating a sense of meaning. Regarding identity, teachers' personal characteristics (mainly resistance to change) constrained them from learning TPACK. Interestingly, teachers' sense of identity enabled by the presence of new entrant teachers (newcomers), who were perceived by other teachers as more technologically knowledgeable, served as a motivating factor. Lastly, the study revealed that these participant primary school in-service teachers were using either strong and/or weak ties to share TPACK both in their hybrid CoPs and with other hybrid CoPs (in other schools) during the shutdown of schools due to the COVID-19 pandemic.

The preceding chapter dealt with the analysis of the findings obtained through data collected from the open-ended survey questionnaires, one-on-one interviews with the selected teachers, and one-on-one interviews with one ($n=1$) principal and two ($n=2$) deputy principals, teachers' scheduled

meeting observations, and document analysis (WhatsApp screenshots) at the three (*n=3*) primary schools. This chapter seeks to provide a more in-depth explanation of the results by discussing them and by drawing on literature to shed light on their significance.

The following themes are discussed in relation to sub-question one as presented in Figure 6.1: *What innovative approaches to form hybrid CoPs are being used by participant primary school in-service teachers in developing their TPACK?*

- 6.2. The spirit of teamwork towards hybrid formation for developing teachers' TPACK
- 6.3. Recognition of the importance of roles held by educators in schools to form hybrid CoPs for TPACK development
- 6.4. Recognition of the influence of educators' common goals towards hybrid formation and TPACK development
- 6.5. The use of communication technologies in forming hybrid CoPs for TPACK development
- 6.6. The presence of ICT tools in schools available to teachers for curriculum delivery towards forming hybrid CoPs to enhance teachers' TPACK

The following themes are discussed in relation to sub-question two as presented in Figure 6.1: *What are the driving factors and constraints around hybrid CoPs in developing these primary school teachers' TPACK?*

- 6.7. The desirability on the part of teachers for CoPs, and teachers' recognition of the necessity for establishing school-based ICT committees
- 6.8. Teachers' lack of confidence hindering TPACK growth in hybrid CoPs
- 6.9. The negative impact of enforced school customs and rules on teachers' TPACK development
- 6.10. Teachers' recognition of the importance of employing effective problem-solving strategies through repeated dialogues for sustaining TPACK development in hybrid CoPs
- 6.11. Resistance of older generation teachers to embracing innovative educational technology

- 6.12. The impacts of experienced and of novice teachers on hybrid CoPs in fostering TPACK development

The following theme is discussed in relation to sub-question three as presented in Figure 6.1: *What was the nature and degree of the strengths of these in-service teachers' relationships in their hybrid CoPs while they were in the process of learning TPACK from one another during the recent COVID-19 pandemic?*

- 6.13. The necessity to bond and bridge in hybrid CoPs for teachers' TPACK development amidst crises, such as COVID-19

The fourth subsidiary question is addressed in Chapter 7 as part of the recommendations, which were aimed at constructing a model using the findings from the three (*n=3*) previously mentioned subsidiary questions. The discussion of the findings in this chapter is guided by the three (*n=3*) theoretical frameworks that form the foundation of this study. These frameworks are the CoP social learning theory (Wenger, 1998), the Strong and Weak Tie Theory (Granovetter, 1973), and the TPACK model (Mishra & Koehler, 2006).

6.2. The spirit of teamwork operating in towards hybrid formation for developing teachers' TPACK

Participant educators reported a sense of bonding among teachers whose common purpose was the sharing of information in relation TPACK. This provided an indication of strong ties between the participant teachers and their colleagues. To be specific, the findings indicate a sense of bonding among teachers during the process of their actively sharing TK, PK and CK. This indicated the presence of strong connections between the educators under study. The literature and the findings of this current study have shown that teamwork and cohesion among teachers in schools may be facilitated by contextual factors such as the physical proximity of their classrooms, and this can foster a sense of connection and kinship among them. The proximity of a colleague's classroom makes it more convenient for a teacher to seek technological support compared to having to reach out to a teacher whose classroom is located further away. Another contextual aspect may arise around lunch periods, when educators have the opportunity to engage in conversation in the staff rooms while enjoying their meal. Evidence of this from my study corroborates the conclusion reached by Cotter et al. (2017) in their research, as previously noted in Chapter 2, Section 2.7. They discovered that casual exchanges among teachers, where they discuss their teaching duties,

difficulties, and chances for improvement, might have helped create a CoP. These informal interactions, like teachers seeking advice from other teachers, as revealed in the current study, could significantly contribute to nurturing the natural growth of a hybrid CoP. According to the results of this current study, teamwork was found to improve mutual engagement at the selected three (*n=3*) schools, which could have had a insignificant influence on the creation of hybrid CoPs at these schools. In this process, educators acquire vital knowledge such as TK, PK and CK.

The most interesting finding from this current study was that teamwork or collaboration had come to extend beyond educators inside the same school, and this was highlighted by one (*n=1*) deputy principal (A). Teacher L at School C demonstrated this even more clearly in his responses in the survey questionnaire: he explained how he often worked with teachers from other schools to solve curriculum problems. Educators have been found to make use of bridging opportunities to access hybrid CoPs outside of their own groups. Where it is possible that some schools do not have teachers with certain expertise or abilities, in-service teachers seek help from other schools. In return, this might lead them to develop weak relationships using bridging with other schools. The present findings appear to agree with those of Mahlo and Waghid (2022), as reported in Chapter 2, Section 2.7. Mahlo and Waghid (2022) discovered that the teachers in their study were able to benefit from establishing a CoP when numerous schools in the same area were working together to share resources, information, and new ideas. Moreover, as mentioned in Section 2.7 of Chapter 2, the research conducted by Xu and Ko (2019) indicated that, when primary school teachers from various schools talk about their classes, this could be seen as mutual engagement. This situation might be ascribed to the existence of schools without highly skilled teachers who are able to address the technological challenges needed for technology-integrated teaching, resulting in the formation of weak connections with nearby schools. Furthermore, the commonalities among the research may be attributed to the fact that all three (*n=3*) studies (Mahlo & Waghid, 2022; Xu & Ko, 2019) and this current study were carried out inside a primary school setting. In addition, the study conducted by Mahlo and Waghid (2022) and the present study both took place in the Khayelitsha township where it was discovered that certain teachers in this area lacked the necessary knowledge and skills for technology-integrated teaching pedagogies. Hence, the findings of this present research indicate that the TPACK difficulties faced by specific schools may naturally lead to the formation of weak ties between teachers belonging to distinct schools. In this

way, hybrid CoPs are not only formed within one school but through teachers from other schools coming together to work as a team.

However, it should be emphasised that there is not consistently a sense of teamwork among teachers in schools, as indicated by the findings of this current study through survey questionnaire responses of four (*n=4*) teachers, two (*n=2*) at school B (Teachers E and F), and two (*n=2*) at School C (Teachers I and L). In essence, these teachers in their survey questionnaire responses wrote that they did not perceive teachers in their respective schools as being cohesive and collaborative in their efforts. Furthermore, Teacher F remarked that time serves as the primary limitation preventing teachers at School B from fostering unity. Teacher E supplemented this perception by stating that, while there was teamwork among teachers at School B, this lacked consistency. This observation strongly suggests that the three (*n=3*) schools (A, B, and C) possessed distinct cultural contexts that could either positively or negatively impact the development of TPACK among their teachers. Cultural contexts can be shaped by various factors, such as instances where the spirit of teamwork might be absent due to a lack of enthusiasm from leadership regarding the use of technology in teaching. Consequently, the utilisation of technology would not be promoted in such environments. These results align with the findings of Mathipa and Mukhari (2014) as discussed in Chapter 2, Section 2.5 They found that inadequate leadership at the school level was identified as a contributing factor hindering the adoption of technology in numerous South African school settings. Furthermore, this discovery aligns with the observations of Winch (1998) mentioned earlier in Chapter 2, Section 2.7, who contended that workplace learning presents various unique situations, each constrained by diverse contexts and cultures. Therefore, based on such studies, and on the current study, I would argue that time constraints are a major issue that may explain the absence of teamwork among teachers in schools, since teachers may not always have time to gather with other teachers to discuss issues relating to their work as discussed by Lohman (2005) earlier in Chapter 2, Section 2.7. Lohman (2005) argues that teachers' engagement in informal learning activities is often hindered by factors such as limited time, physical distance from colleagues' workspaces, and financial limitations. However, educators may effectively address or overcome these challenges by using online communication technologies, which will be further explored in subsequent sections of this chapter.

6.3. The importance of roles held by educators in schools to form hybrid CoPs for TPACK development

With reference to the findings in Chapter 5, Section 5.2.1.2, the analysis of survey questionnaires and one-on-one interviews with participants revealed the significant influence of principals, deputy principals, and highly skilled and knowledgeable teachers on fostering mutual engagement in schools. The findings of this current study have shown that the practice of principals and deputy principals disseminating crucial and up-to-date information on teachers' use of technology in the realm of learning and teaching, predominantly with the use of WhatsApp group chat to bond and bridge while creating both strong and weak ties, is widely seen by participant teachers as a significant effort. Principals and/or deputy principals may take on this role of distributing such information to teachers, recognising it as part of their duties. Crucially, these educators also disseminate information amongst one another pertaining to the use of technology in curriculum delivery, as they firmly believe that both teachers and learners can derive benefits from integrating such technologies. This observation is in line with the findings of Hart (2023) as cited in Chapter 2, Section 2.5.2. Hart (2023) contends that leaders who are proactive and demonstrate a visionary mindset possess the capability to tackle challenges faced by learners which are specifically due to their and their teachers' limited access to technology and to a lack of technological knowledge. Additionally, it is worth mentioning that findings of the current study have shown that many school leaders increasingly prefer using WhatsApp group chat as their primary communication method over emails. The preference for WhatsApp among these school leaders could be attributed to their past experiences, possibly encountering reluctance among other teachers to utilise emails. It's even possible that some of these teachers do not have email accounts. However, this discovery would seem to contrast with the findings of Pollock and Hauseman (2019) as outlined in Chapter 2, Section 2.9, who found in their research that the use of emails by principals in certain Canadian schools was the preferred method. They highlighted the benefits of email, such as providing convenient and efficient communication with stakeholders. However, the disparity in the findings between this current study and previous research like that of Pollock and Hauseman (2019) could be attributed to the different contexts in which the studies were conducted. This current study was conducted in a previously disadvantage community in South Africa, a developing country, while the study of Pollock and Hauseman (2019) was conducted in a more developed country. In such diverse contexts, practices may vary due to factors such as the quality of TPD initiatives and

financial resources. Hence, the findings of this present study showed that efficient communication using WhatsApp group chats by and among principals, deputy principals, and teachers played a significant role in advancing teachers' development of CK within the school environment which was the setting for the current study. Consequently, at these schools, this method of communication was found to be facilitating mutual engagement with some success, ultimately contributing to the formation of a hybrid CoPs at the schools under study.

The findings of the current study have also shown that the presence of teachers who possessed more expertise and understanding in using technology for teaching purposes was seen by their peers as crucial in fostering the formation of hybrid CoPs. Some teachers were perceived by their peers as more adept and knowledgeable in utilising technology for teaching within schools. These teachers might formally or informally tend to assume mentorship roles for their less technologically knowledgeable colleagues. Whether intentional or unintentional, the mentorship roles undertaken by these teachers can be influenced by their personal beliefs and previous experiences on the use of technology. This phenomenon was observed in a study discussed earlier in Chapter 2, Section 2.1 by Lecat et al. (2019), which highlighted the significant role of direct colleagues in refining teaching methods, discovering new approaches to teaching, and seeking advice on classroom management. Similarly, as detailed in Chapter 2, Section 2.10, consistent with the findings of Kim et al. (2021), teachers may assume the role of mentees due to dissatisfaction with government organised TPD programmes, believing that the support they require is available within their school community, particularly among their colleagues. The findings of this current study showed that in all three ($n=3$) schools (A, B and C) teachers were acquiring TK and CK from other teachers. Also, at School B and C, the study revealed that teachers were developing their PK with help from the more experienced teachers in terms of the number of teaching years. Thus, from this one could see that the roles assumed by the so-called knowledgeable teachers in this capacity were assisting in the fostering and sustaining of mutual engagement, which was serving as an innovative approach, one that could potentially foster the development of a hybrid CoP.

6.4. Recognition of the influence of educators' common goals towards hybrid formation and TPACK development

The finding in this regard in the literature also suggests that teachers may not always unite around a shared objective but would instead do so based on their collective unity. However, this was not observed in this study. Instead, the results indicated that common goals were in fact the driving force behind teachers at the three (*n=3*) schools coming together. For example, according to the information presented in Chapter 5, Section 5.2.2.1, the survey questionnaires and teacher interviews revealed that teachers' collaboration and mutual support inside the selected schools were being driven by a common goal. The interviews confirmed this discovery, as it was reaffirmed by three (*n=3*) teachers (B and C) at School A, Teacher L at School C, and two (*n=2*) deputy principals (A and B) at School A and B respectively. This finding supports the notion put forth by Chigona (2013) and Jho et al. (2016) in Chapter 2, Section 2.7, that mutual engagement, joint enterprise, and shared repertoire are approaches that contribute to the formation of a CoP. These emerge when teachers engage in communication and collaborative work to achieve a shared objective. The present findings demonstrate that all three (*n=3*) teachers (B, C, and L) and both deputy principals (A and B) described a common goal which was to actively work as a team with colleagues in order to gain information that would enhance the learning experiences of learners. These educators had become united due to a shared aim which was to acquire TPACK from one another. The reason they needed to do this was because, as advocated by Koehler and Mishra (2005) and Koehler et al. (2014) mentioned in Chapter 2, Section 2.2, these may have seen their need for TPACK to integrate technology effectively into their teaching.

Thus, this discovery in my study is consistent with the research conducted by Cobb et al. (2003) as described in Chapter 3, Section 3.2.1.3. Their study focused on secondary school Mathematics teachers who shared the goal of being able to ensure their learners' comprehension of fundamental mathematical principles and for them to achieve high performance in Mathematics evaluations. The possible explanation for similarities between the findings of this current study and the findings of previous studies, such as those of Cobb et al. (2003), may be the fact that some of the educational goals of the teachers in both their and my study could ideally be seen as universal goals. In other words, educators everywhere strive to help their learners succeed academically, regardless of where their schools are located or the subjects they cover. Furthermore, even though the research done by Cobb et al. (2003) took place two decades ago, their conclusions may still be applicable.

This implies that the conclusions drawn in one setting may be transferred to comparable scenarios or individuals. The information gained in one environment remains applicable in another, and researchers in a different context may use specific notions that were first produced by other researchers, as emphasised in Chapter 4, Section 4.8.2 by Holloway (2016). The findings of this current study highlight the importance of common goals in promoting mutual engagement that, according to the participant educators' comments, ultimately contribute to the creation of dynamic hybrid CoPs for the development of teachers' TK and PK.

6.5. The use of communication technologies in forming hybrid CoPs for TPACK development

The participant educators' analysis conducted in Chapter 5, Section 5.2.3.1, using survey questionnaires, semi-structured interviews, and document analysis (specifically WhatsApp screenshots) of School A and C's population, revealed that public primary school teachers primarily utilise communication technologies such as WhatsApp to discuss both curriculum and non-curriculum matters in the participating schools. This discovery corroborates the assertion by Asmara (2020) in Chapter 2, Section 2.9, who found in her study that WhatsApp is a widely used social networking tool in Indonesia, one that facilitates effortless communication and interaction among individuals. The findings of this current study and teachers in general as found in the literature, are likely to participate in online CoPs using social media platforms like WhatsApp. They do this to gain professional development opportunities and acquire information that may improve their teaching in the classroom. This conclusion aligns with the study conducted by Moodley (2019) as outlined in Chapter 2, Section 2.9. Moodley discovered that WhatsApp was used by participants in his study to monitor and provide further professional assistance to educators after their completion of an in-person professional development course. Similarly, the findings of this current study revealed WhatsApp to be the prevailing communication tool used by public primary school teachers for the purpose of establishing and strengthening relationships, as well as for exchanging crucial information such as PK and CK. Therefore, from this current study, supported by the findings on this exchange and sharing of information by participant teachers, I conclude that there is a strong likelihood of the use of WhatsApp group chat feature as a shared repertoire to promote the formation of hybrid CoPs, and that this may contribute to teachers' acquisition and strengthening of their PK and CK.

The analysis of WhatsApp screen shots of teachers from School A and C (Figure 5.2 and 5.3) presented in Chapter 5, Section 5.2.3.1 reveals that creating and sustaining shared repertoires, specifically through teachers' WhatsApp group chats, is a novel method that was being used by educators in School C to share TK, PK, CK, PCK, TPK, TCK, and TPACK. This is shown in Figure 5.3 in Chapter 5, which displays a screenshot of a picture shared in a WhatsApp group discussion by a teacher at School C. The image provides information about particular pieces of knowledge related to the use of technology in teaching (TK, PK, CK, PCK, TPK, TCK and TPACK). This statement does not assert or presume that these educators were acquiring or would acquire all of this knowledge from each other since the data shown in Figure 5.3 is insufficient to demonstrate the comprehensive acquisition of such knowledge (TK, PK, CK, PCK, TPK, TCK and TPACK). Figure 5.3 only presents empirical data indicating that the participant educators were exchanging information on TK, PK, CK, PCK, TPK, TCK and TPACK. This discovery corroborates the results of Ajani (2021) as described in Chapter 2, Section 2.9, which highlighted the content of WhatsApp group chats as a crucial factor in enabling teachers' professional growth. Teachers' comments and WhatsApp screenshots, as Davis (2015) suggested in Chapter 2, Section 2.8 suggest that teachers should be given the opportunity to reflect on their methods, exchange information, and interact with colleagues. One potential reason for the widespread adoption of WhatsApp among primary school teachers for purposes of enhancing their hybrid CoPs might be attributed to the core functionality of WhatsApp, which centres on its group chat and messaging capabilities. These features are likely to facilitate the participation of members of a CoP in the exchange of various types of media and in the deliberation of various issues. This is one result of this platform enabling the facilitation of the rapid exchange of information among colleagues, and this has the potential to lead to the formation of a hybrid CoP. Thus, the findings in this study indicate that, due to its perceived simplicity of use, teachers are more motivated to utilise WhatsApp than they are to other social media platforms or communication technologies.

Moreover, WhatsApp's phone and video call functionalities provide greater convenience and more complete communication compared to other social networking platforms. Literature (Ajani, 2021) further showed that teachers may actively participate in collaborative conversations, reflect on classroom experiences, and engage in debates around their educational practice, using both synchronous and asynchronous aspects of WhatsApp. However, the results of this current study suggest that the participant teachers were utilising WhatsApp in an asynchronous manner. As

Neumayr et al. (2021) explain in Chapter 1, Section 1.23, this indicates that teachers share information in their WhatsApp group chats, and other teachers who are recipients of the message view these messages later, at their convenience. These teachers may have chosen the asynchronous technique over the synchronous approach because of its inherent flexibility, which allows participants to access messages at their convenience and from any location. This discovery, together with findings from previous research, suggests that it is important to acknowledge WhatsApp as a successful and inventive platform for creating and sustaining shared knowledge among in-service teachers, and in convenient and efficient ways. This finding suggests that hybrid CoPs have the capacity to adapt to the swift evolution of communication technologies, exemplified by the inclusion of relatively recent innovations like WhatsApp, compared to longer established communication technologies such as video conferencing and emails.

6.6. The presence of ICT tools in schools available to teachers for curriculum delivery towards forming hybrid CoPs to enhance teachers' TPACK

The survey questionnaires and interviews revealed that participant in-service teachers were sharing teaching materials in effective ways, including resources such as MCO, CAMI, Click Foundation programmes, and Smart classrooms. These resources were provided to public schools by the WCG. The involvement of the WCG in providing these tools highlights the significance of institutional support in promoting collaborative practices. However, conversely, this finding brings up serious concerns about the unequal support of school subjects within schools. For instance, as previously elucidated by Hardman and Tshink (2019) in Chapter 2, Sections 2.4.1 and 2.4.2 respectively, MCO and CAMI Maths are specifically allocated to schools to strengthen Mathematics teaching and learning, to the exclusion of other subjects. This may suggest that other school subjects may not receive the same level of attention as Mathematics does. This perception is consistent with the claim put forward by Perryman et al. (2011) as previously discussed in Chapter 2, Section 2.4. They argue that English and Mathematics departments may receive more attention in comparison to other academic disciplines. This preference may be linked to the fact that these disciplines are studied by the whole school cohort and owing to the traditional focus on reading and numeracy.

Also, the findings highlight the notion that schools may not receive equal levels of technological support across all provinces in South Africa, as some provinces may not prioritise investing resources in schools for this purpose, or they may lack the necessary financial means. This

observation resonates with the findings of Lembani et al. (2020) discussed earlier in chapter 2, section 2.3. They argue that, while ICT integration has been effectively implemented in numerous schools in urban areas of South Africa, the same level of integration has not been achieved in rural schools. Therefore, if resources become available to a certain school(s) or area, it might be easier for teachers to share these resources since they might be the only resources accessible to them. While teachers may not necessarily receive training in how to use these resources, the presence of an encouraging and positive cultural context—where some teachers are already utilising these resources—could motivate others to learn how to use them. The findings of Lembani et al. (2020) challenge and contradict the conclusions drawn by Buckenmeyer (2010), Dlamini and Mbatha (2018), and Mahlo and Waghid (2023) as discussed earlier in Chapter 2, Section 2.1. These scholars asserted, respectively, that prior to teachers being provided with physical technologies, they need to receive training on how to use them. The results of this current study also diverge from the recommendations put forth by Koehler et al. (2014) and by Graham et al. (2020) as discussed in Chapter 2, Section 2.2. These scholars suggested that it is not advisable for governments and schools to invest excessive amounts of money in current technology if teachers lack the knowledge to integrate it effectively into their teaching. However, I would argue that this should not always be the case. The findings of this present study provide evidence that deploying technologies in schools before providing teachers with organised TPD sessions by district offices and provincial governments might be a push factor encouraging teachers to collaborate as a team. In this process, as shown in this study's findings, teachers may acquire and strengthen their PK, TK, CK and TPK from one another in their schools. Eventually, this shared repertoire of ICT teaching equipment such as MCO and CAMI Maths may lead to the formation of hybrid CoPs.

6.7. The impact of school-based ICT committees on teachers' TPACK development in hybrid CoPs

The data analysis from the interviews and WhatsApp screenshots in Chapter 5, Section 5.3.1.1 identified school-based ICT committees as a support mechanism that teachers in need of help with technology integration in their classrooms may utilise. According to the participant teachers, these ICT committees are made up of SMT members and teachers. The active role of school-based ICT committees was evident in the analysis of WhatsApp screenshots from School A and School C in Chapter 5 (see Figures 5.5 and 5.6), where it appeared that committee members have their own

WhatsApp group chat within the schools to discuss issues relating to the use of technological tools for teachers' pedagogical practices. Thus, the data suggest that, through this social structure, teachers were building a feeling of belonging (community), which may act as a motivator for the teachers' development of TK in their hybrid CoPs. As observed from the findings from this date, this finding is consistent with Shiburi's (2021) recommendation outlined in Chapter 2, Section 2.5.1 that school principals and department heads be involved in school-based ICT committees. One probable reason for this is that school principals and departmental heads function as accounting officers and play an important role in guiding curriculum in schools. In light of this, it is essential for them to join the school-based ICT committees in addition to teachers at the school. However, there is a possibility that the similarities between the findings of the current study and those of Shiburi (2021) in this regard are due to the fact that both of the studies were carried out in South Africa, a country in which public schools are most likely governed by national policies such as the White Paper 7 on e-Education (DoE, 2004), mentioned earlier in Chapter 1, Section 1.2, and in Chapter 2, Section 2.3. It is also possible that the schools that participated in both of these studies are geographically located in similar contexts, and in communities that were previously marginalised, and one could argue that in some ways they remain marginalised. This similarity could lead schools to adopt similar strategies, depending on what practical and human resources they have on their disposal to enable them to address the issue of inadequate utilisation of technology for curriculum delivery. However, in this current research, it was noted that the school-based ICT committees of schools A and C did not include parents and other IT experts. These schools, particularly School A and C, did not appear to be adhering to the kinds of recommendations made by Vanderlinde et al. (2011) in Chapter 2, Section 2.5.1. Their study concluded that school-based ICT committee should consist of a variety of different stakeholders, such as parents and Information Technology (IT) professionals who have specific responsibilities within the committee. Schools often fail to recognise the significant contributions that third parties might provide. Having parents who are IT/ICT specialists as external members of the school-based ICT committee carries the potential to provide expertise and assistance with technology-related problems in schools. This link has the potential to strengthen teachers' hybrid CoPs in the process of their acquiring crucial information such as TK, as is shown in the findings of this current study.

Additionally, Razzak (2015) and Shiburi (2021) recommend, as previously described in Chapter 2, Section 2.5.1, that the responsibility for creating an ICT policy for schools should be given to a

specialised committee whose focus is ICT concerns inside the school. Although the data analysis in this current study does not explicitly state whether school-based ICT committees are responsible for designing and implementing school-based ICT policies, it can be inferred that these committees are likely to play an active role in policy design due to their important responsibility for promoting the use of technological tools in schools. Website support, technical help, network maintenance, and IT fundraising are among the many responsibilities that may fall within the purview of a school-based ICT committee, as mentioned by Vanderlinde et al. (2011) in Chapter 2, Section 2.5. The results of this current study and previous research suggest that, for educators to successfully utilise technology in their teaching, they need support mechanisms that help them improve their ICT competency and confidence in the use of IT. As shown by the findings of this current study, the existence of these ICT committees inside schools may enhance teachers' sense of belonging, and in this way fostering their drive to acquire TK and TPK from one another in their hybrid CoPs.

6.8. Teachers' lack of confidence hindering TPACK growth in hybrid CoPs

With reference to the findings reported in Chapter 5, Section 5.3.1.2, teachers' lack of confidence to utilise technology for pedagogical purposes led to their feelings of isolation and of not belonging to their respective hybrid CoPs. This discovery suggests that some teachers in these schools lack the confidence to actively seek help from their colleagues inside the same school since they typically perceive themselves as not wanting to be viewed as troublesome. Their lack of confidence could stem from negative past encounters in which other teachers declined to offer them assistance with technology use. It is possible that some technologically knowledgeable teachers become frustrated by frequent requests for assistance from colleagues regarding technology usage. Consequently, some teachers choose never to seek help from others. These findings suggest a lack of teacher unity in some of these schools, and the result of this can be poor interpersonal interactions on the part of these teachers. The difference in confidence levels among teachers in different contexts can also be linked to variations in the leadership styles employed by school principals or their deputies. Knipp (2019) suggests that leaders might boost teachers' knowledge and self-confidence by providing opportunities for them to interact with colleagues, as mentioned in Chapter 1, Section 2.5.1. If teachers have an ultra-cautious perspective towards seeking assistance or working collaboratively, it may impede the potential sharing of essential information for successful technology-based teaching in these communities, as well as inhibiting the formation

of a feeling of community among teachers in hybrid CoPs. Educators who have a strong sense of belonging within their hybrid CoPs are less likely to feel humiliated or reluctant when seeking help from their colleagues about the use of technology into their teaching methods. The study's findings, from comments specifically made by Teacher F at School B, and Teachers J, K and L at School C, suggest that a lack of a sense of belonging amongst the teachers at their respective schools may have hindered their ability to acquire TK, TPK, TCK, and TPACK in their hybrid CoPs. This finding provides the implication that many teachers at these two schools were less confident to utilise technology in their teaching than were other teachers. Thus, in this context, while community may serve as a motivating factor in certain of the hybrid CoPs examined in the present research, it can also impede teachers' TPACK development if they develop emotions, or a sense of exclusion and a lack of strong affiliation. Furthermore, this finding suggests that the feeling of community plays a significant role in the strength and effectiveness of hybrid CoPs. Although a sense of belonging may motivate educators in some situations, its absence might impede the development of teachers' TPACK if they feel isolated and lack a strong sense of belonging both in their schools and within a CoP context.

6.9. School customs and rules hindering TPACK development in hybrid CoPs

Based on the findings outlined in Chapter 5, Section 5.3.2.1, I noted that the customs and/rules implemented by school principals, as reported by Teachers B and C at School A, Teacher G at School B, and Teacher I at School C, seemed to pose a limitation towards teachers acquisition of knowledge related to TPACK from their colleagues inside the hybrid CoPs. As per the comments provided by Teachers G and I, who stated that teachers at their school would not be allowed to utilise technological resources beyond a certain period if they requested them. This finding aligns with the findings of Dube et al. (2018) as detailed in Chapter 2, Section 2.5.1. Dube et al. (2018) reported unhappiness among some teachers in various South African primary schools due to established rules and customs enforced by school leaders, in particular by principals. Their study revealed that certain teachers in selected South African primary schools expressed discontent with the rules enforced by school leaders, notably by principals. School principals' attitudes might impact their decisions to create the kinds of rules that either encourage or restrict teachers from using technology in their classrooms. For instance, school principals might prioritise teachers of specific school subjects that they think, the principals consider to need technology more

than other subjects. If the school principal deems a school subject less vital than other subjects, teachers of those subjects may not be permitted to use accessible technology in their classrooms. An obvious risk connected to this rule and custom is that learners may see some school subjects as less significant than others, resulting in poor motivation and academic achievement in those areas. In this study, it appeared that the principals at all three (*n=3*) schools (A, B and C) were enforcing such rules due to a lack of available technologies in their schools, rather than attaching importance to certain subjects. It seemed that these principals were implementing these rules and customs to ensure that their teachers had equal access to the limited technologies, and this might have been the simplest approach to organising their distribution and usage. Thus, I contend that the scarcity of technology should not be a reason for school principals to restrict some teachers from using them. Rules and customs should be enforced only if they are advantageous to all teachers and learners, irrespective of the school subject being taught. This stance might enhance learners' motivation to achieve in all school subjects if they see them as equally significant. However, there is no doubt that this dissatisfaction of some participant teachers with rules was hampering their ability to use and integrate technology effectively into their teaching practices. Thus, in this regard, practice characterised and moulded by these rules and customs could be seen to hinder teachers' development of TK, TPK, TCK, and TPACK in their hybrid CoPs.

6.10. Teachers' effective problem-solving strategies through repeated dialogues for sustaining TPACK development in hybrid CoPs

It is important to note that the findings in this current study indicated that in-service teachers are sometimes able to bond and bridge for the purpose of discussions with colleagues in other schools to address issues and find solutions related to the use of technology in the context of teaching and learning. It is possible to conduct these conversations in person or on social media platforms like WhatsApp. For example, the "brief meetings" that take place before the start of the school day at these three (*n=3*) schools make it easy for teachers to form ties, generate and negotiate meanings within their own schools. This is because these meetings are being held on a consistent and recurrent basis on specific days of the week at these schools during the school day. As can be seen in Chapter 3, Section 3.2.2.1, this finding lends support to the concept proposed by Batchelor (2020), Cotter et al. (2017) and Holland (2018), all of whom share the view that a robust CoP is characterised by the development of repeated dialogue among its members. This dialogue enables

the members to collectively generate problem-solving strategies and address issues that are related to their practices in effective ways. Consistent findings from this current research highlight the value of open dialogue between coworkers as a means of strengthening relationships within hybrid CoPs. Chapter 3, Section 3.2.2.2 reiterates the argument put out by Stănescu et al. (2022) that communication is the foundation upon which relationships are built and communities are structured. Relevant patterns and norms of communication emerge inside the group, patterns which are known to all members. Another possible explanation for the concurrence in the findings of this current study and that of previous research (Batchelor, 2020; Cotter et al., 2017; Holland, 2018), might be attributed to the common use of the CoP social learning theory by these researchers as the theoretical framework.

Furthermore, these findings align with the proposition put forth by Ajani (2021), Lantz-Andersson et al. (2017), and Moodley (2019) in Chapter 2, Section 2.9. These authors suggested in their individual studies that social media groups can serve as effective platforms for teacher professional discussions, promoting collaborative problem-solving, sharing of resources, and exchanging teaching experiences and examples. These studies suggest that social media can be seen as an extended virtual space like a staff room, where educators come together to participate in teacher-led professional discussions about teaching methods and to address practical teaching difficulties. The most intriguing aspect of the meeting observations and the analysis of WhatsApp screenshots presented in Chapter 5, Section 5.3.1.1 is the teachers' apparent ease in using Isixhosa language instead of English as the primary language of communication inside their hybrid CoPs. Explaining this finding poses a challenge for this current study due to its absence in existing literature cited in my study. However, a plausible explanation could be that the prevalence of Isixhosa as the primary language spoken in Khayelitsha township, and its status as the mother tongue for many residents, may contribute to teachers feeling at ease communicating in this language. This finding aligns with Wenger's (1999) definition of "negotiation of meaning" in the context of a CoP as discussed in Chapter 3, Section 3.2.2.2. According to Wenger (1999), this concept encompasses multiple elements including language usage, reaching consensus, and carrying out a task that requires focused attention and adjustments. This present study's finding emphasises the significance of taking into account linguistic elements while teachers are in the process of developing their TPACK in their hybrid CoPs. This implies that establishing hybrid CoPs that allow educators to use their choice of language, if English is not their mother tongue, promotes a more cohesive and

efficient hybrid CoP for addressing issues pertaining to teachers' development and use of TPACK. Thus, the findings in this regard indicate that practice characterised by teachers' problem-solving strategies and engaging in repeated dialogues in their mother tongue to negotiate meanings motivated teachers' acquisition of TK, PK and TPK within their hybrid CoPs.

6.11. Resistance of older generation teachers to the integration of technology into pedagogy

The findings presented in Chapter 5, Section 5.3.4.1 indicate that the reluctance of older generation teachers to embrace new technologies can hinder their ability to become proficient in using technology for teaching and learning. This resistance to change is considered by some scholars (Umugiraneza et al., 2018) as a negative characteristic that may limit certain teachers' competence in this area. In the current study, the finding on the existence of this reluctance was reaffirmed by four (*n=4*) educators. For example, Teacher E, at School B explicitly said that several colleagues saw their age as a hindrance to acquiring technological knowledge for their teaching practices, therefore deeming it unnecessary for them to acquire this knowledge. Consistent with the current findings, prior research has shown that teachers may grow increasingly reluctant to incorporate technology into their lessons as they age. The presence of this phenomenon among older teachers is supported by the work of Umugiraneza et al. (2018), which is discussed in Section 2.5.4 of Chapter 2. Some in-service teachers from previous generations may be less comfortable with, and accustomed to, using technology in their classrooms due to their not having had consistent exposure to it during the period of their employment. It should be noted that these teachers' resistance at this time has a detrimental impact on both their learners and themselves. By failing to make use of these tools, teachers are essentially denying their learners the educational benefit of these resources.

According to Munje and Jita (2020), cited in Chapter 2, Section 2.5.4, technology has the potential to lower failure rates, with the result that fewer learners would be in need of extra help to satisfy promotion requirements. Hence, drawing on the studies carried out by Munje and Jita (2020), Umugiraneza et al. (2018), and the current study, it can be inferred that the reluctance of older teachers to embrace change significantly influences their choice to acquire knowledge related to TPACK from their colleagues. It is possible that the identities of some older teachers may be linked strongly to their traditional teaching methods; they may fear that embracing modern

approaches could mean abandoning techniques with which they are familiar. Additionally, there could be a belief among these educators that integrating technology into teaching is counterproductive, perceiving it as consuming valuable class time being spent setting it up and with troubleshooting, and this may lead them to perceive traditional methods as more effective. This kind of reasoning on the part of older teachers aligns with the findings of Mathipa and Mukhari (2014) who observed that certain teachers resist using technology in the classroom because they perceive it as offering benefits neither to themselves nor to their learners. Resistance to change by teachers might have a detrimental impact on their professional identities, since these older generation teachers might not be able to fully become members of a hybrid CoP at their school. The consistency of findings among the referenced studies in this section and the current study can be attributed to the fact that all of them were carried out in South Africa, indicating that this issue is prevalent in most schools in the country and that certain teachers lack awareness regarding the advantages of incorporating technology in their classrooms possibly partly due to the nature of their training – which took place some years prior to the training received by their more recently graduated colleagues. This highlights the seriousness of the problem of insufficient use of technology in South African schools and necessitates immediate action by the national and provincial governments, by districts offices and by schools to tackle and mitigate this deficiency. To tackle this deficiency, it is necessary to implement specific and well-designed interventions. These interventions should include training that is appropriate for different age groups, as well as mentoring programmes that include elements of both hybrid CoPs and traditional approaches. The focus of these programmes should be on highlighting the importance and advantages of technology in improving teaching methods for all teacher age groups. Therefore, this specific characteristic (resistance to change) of some teachers may be accepted as a reality by the aforementioned bodies and institutions and as a constraint to the development of teachers' TK, TPK, TCK and TPACK in their hybrid CoPs.

6.12. The relative influence of seasoned and new entrant teachers on TPACK development in hybrid CoPs

With reference to the findings of studies cited in Chapter 5, Section 5.3.4.2, and as indicated in some participants' interview responses in this current study, newly qualified teachers expressed their gratitude for the accessible assistance provided to them by senior teachers to develop and

improve their TPACK. This finding is consistent with the study done by Schlager and Fusco (2003) as described in Chapter 2, Section 2.6, which posited that newcomers gain entry to a community's professional knowledge tools and social norms by actively engaging in genuine activities alongside seasoned teachers. Lave and Wenger's (1991) principle of legitimate peripheral participation is described in Chapter 3, Section 3.2. This form of participation, with core members of the CoP being regarded by other, perhaps more recent members, as the most knowledgeable members, is consistent with this finding of newly qualified teachers gaining access to knowledge essential for their effective and successful curriculum delivery through active participation. According to Phillips (2014), a CoP is an ever-changing setting where newcomers may gain access to knowledge and take part in group activities (Chapter 3, Section 3.2.2.4). According to the results of this current research, it seems that not all educators who have been in the profession for a long time, or who belong to the older generation, are lacking in important knowledge such as PK, PCK and CK. This study further implies that newly qualified teachers develop a feeling of belonging (identity) because of the professional help they receive from seasoned teachers. This may serve as a motivating factor for these newcomers to successfully absorb knowledge related to TPACK in their hybrid CoPs.

Nevertheless, the noteworthy and unexpected aspect of this discovery was the remarks provided by Teachers A and F in the survey questionnaires. These suggest that newly employed teachers, namely those who have very recently entered the teaching field, have more skill and knowledge in the use of technology compared to seasoned teachers. Perhaps this phenomenon might be ascribed to the newly employed teachers' increased familiarity with modern educational technologies acquired in the course of their teaching degrees. This discovery seems to be consistent with the findings reported by Baya'a et al. (2019) cited in Chapter 2, Section 2.7, who discovered similar results in their separate study. Novice teachers sometimes have less classroom experience, although they may demonstrate heightened abilities in using technology for teaching. In this scenario, newcomers may be seen as core members due to their superior knowledge and expertise in using technology for teaching, a level of expertise surpassing even the more seasoned educators in terms of years of experience. This discovery contradicts Lave and Wenger's (1991) notion of legitimate peripheral involvement, which specifies that core members of a CoP are the most informed, as mentioned in Chapter 3, Section 3.2. The findings of this present research suggest that core members are not always the most informed; in some situations, newcomers might be the

most knowledgeable. The current study indicates that seasoned teachers may possess more knowledge and expertise in a subject (CK), pedagogy (PK) or subjects, and pedagogy (PCK) while novice teachers may have more understanding of technology (TK) as they have learnt about and used it while pursuing their teaching degrees. By observing and acquiring TK from these inexperienced (in terms of years of teaching) teachers, the seasoned teachers may enhance their professional identities, since they will be able to use and integrate technology (TK) effectively and confidently into their teaching practices. Hence, the feeling of belonging (identity) may be regarded as the driving or motivating factor for the development of teachers' TK in their hybrid CoPs.

6.13. The necessity to bond and bridge in hybrid CoPs for teachers' TPACK development amidst crises, such as COVID-19

Based on the interview responses of four (*n=4*) teachers (C, D, K, and L) at School A and C respectively, teachers frequently used WhatsApp to share and exchange knowledge within their hybrid CoPs during the COVID-19 lockdown. The findings indicate that the teachers formed strong ties with one another by means of the exchange of knowledge and the provision of emotional support to one another during the course of their work. During the lockdown and concomitant limited school attendance, teachers verified and indicated that the majority of the information they communicated was related to learner class activities, and it is possible that this is connected to CK. Regarding this, the results of the present study appear to suggest that educators from both the sample schools and other schools in the same demographic area valued, and continue to value, the assistance they received from colleagues. As mentioned in Chapter 2, Section 2.10, the results of this current study align with those of Kim and Asbury (2020) and with those of Kim et al. (2021). The findings of these studies concur that educators in their studies valued their professional ties with fellow educators during the COVID-19 closure of schools. In fact, several researchers discovered that these professional relationships evolved into genuine friendships, which served as an invaluable support system. Also, Kim et al. (2021), as cited in Chapter 2, Section 2.10, found that most classroom teachers believed that the support they required existed within their own schools, specifically offered by their peers, and that online professional and social activities were regarded by some teachers as career highlights.

Thus, as discussed in Section 2.10 of Chapter 2 by Glessner and Johnson (2020), special education teachers reported placing a higher value on interpersonal communication with their peers than they had done before when using distance learning strategies, and that this resulted in the development of strong ties among these educators during the pandemic. These teachers remarked that they worked together more closely during the COVID-19 pandemic, with virtual meeting places being especially useful. Since COVID-19 impacted schools all over the world, and because the global education sector responded to the crisis in a similar way—that is, by forcing teachers to embrace online technologies to teach learners effectively, and to share information amongst themselves—the present study's and previous studies' findings are consistent with one another. It may have been a natural reaction on the part of teachers to create these deep bonds during the pandemic crisis, providing one other with emotional support and exchanging professional knowledge. This conclusion is also in accordance with the findings of Kim et al. (2021), which suggested that the habit of teachers seeking knowledge and emotional support from colleagues inside schools might have developed from natural, human impulses among teachers. Despite the strong emotional and collegial relationships formed among teachers, this study indicates that there was a lack of meaningful sharing of knowledge related to TPACK during the closure of schools due to COVID-19. In this current study, the analysis of the interview data revealed that teachers only acquired CK inside their hybrid CoPs throughout the COVID-19 period.

In Chapter 5 the data analysis shows that teachers were able to establish weak ties by means of bridging. This allowed them to exchange and access CK and PK from other hybrid CoPs set up in other schools in the area during the school closures caused by COVID-19. As a consequence, the results in this respect demonstrate that, during the COVID-19 school closures in South Africa, the sampled in-service teachers were more likely to communicate a greater quantity of knowledge by means of bridging than through bonding. This data seems to confirm the theory advanced by Erickson (2004) and Lin (2001) that a person's weak ties provide them access to more people and resources in their community. Furthermore, this finding aligns with the findings of Alwafi (2021), who determined in their research that teachers seemed to have formed weak ties when engaging virtually with other professionals on Twitter throughout the COVID-19 epidemic. These previous studies emphasise the importance of weak connections as a means of sharing and accessing TPACK among teachers in hybrid CoPs during the COVID-19 pandemic. In the context of exchanging extensive information, the findings of the present study and the aforementioned

previous studies indicate that weak ties were preferred by participants over strong ties. This finding contradicts the findings of earlier research conducted by Lu et al. (2022), a contradiction stressed in Chapter 2, section 2.10. Lu et al. (2022) showed that individuals in their study were more inclined to share information within their strong tie network than amongst their weak tie networks. One potential reason for this might be the lack of consideration for the various kinds of CoPs and data collection tools used in both the present and prior study conducted by Lu et al. (2022). For instance, Lu et al. (2022) used a quantity survey instrument to gather data from a cohort of adult citizens residing in various communities in China, while this present study utilised a group of professional educators and a range of data collection tools, including two qualitative research tools. Based on this discovery, it can be inferred that, during the COVID-19 pandemic, the in-service teachers in my study opted to use weak ties built by means of bridging as a means to exchange information which included CK and PK during the closure of South African schools due to lockdown.

6.14. Chapter summary

This chapter discussed the findings of the study in detail. The findings responded to three (*n=3*) of the four (*n=4*) subsidiary research questions and provided insights into the influence of hybrid CoPs on the development of primary school in-service teachers' TPACK in a historically disadvantaged area of Khayelitsha in the Western Cape province of South Africa. This study revealed that a sampled group of in-service primary school teachers were adapting certain innovative approaches in their forming of hybrid CoPs in the process of developing their TPACK, although to a limited extent. It's important to highlight that in this study's hybrid CoP formation process, it's not limited to the 12 teachers who were the primary participants. Instead, it encompasses all teachers (populations) across these three (*n=3*). This broader inclusion is because, at times, the 12 participants were sharing insights or experiences related to all teachers in their respective schools regarding CoP formation and the development of TPACK. Based on the discussion of findings, the spirit of teamwork was found to be a vital characteristic motivating the innovative approach of mutual engagement in this process, one that carried the potential to lead to the formation of hybrid CoPs for the specific purpose of these teachers' TK, PK and CK development. The significant roles of principals, deputy principals, and highly skilled and knowledgeable teachers in fostering mutual engagement appeared to be important factors

influencing the formation and sustaining of hybrid CoPs for teachers' TK, CK and PK development. Educators' common goals promoted mutual engagement, that according to the participant educators' comments on what was happening at their schools, ultimately contributes to the creation of hybrid CoPs for teachers' TK and PK development. WhatsApp was found to be an effective and innovative platform for the establishment and maintenance of shared repertoires, and in fostering the presence of hybrid CoPs for in-service teachers' TK, CK and PK development. Additionally, through the WhatsApp screenshots data analysis of School C, the study found that participant educators at this school were sharing information relating to TK, PK, CK, PCK, TPK, TCK, and TPACK. Teachers were also acquiring PK, TK, CK and TPK from each other within their schools, a process potentially resulting in the development of hybrid CoPs facilitated by shared ICT teaching tools (shared repertoire), such as MCO and CAMI Maths. In addition, the findings revealed several insights about the factors either motivating and/or depriving teachers to acquire and develop their TPACK in their hybrid CoPs. The presence of structures, such as the school-based ICT committees in schools, were found to have contributed to teachers' sense of belonging (community), and this had the potential to increase teachers' motivation to learn TK from one another in their hybrid CoPs. While the literature has shown, a strong feeling of belonging (community) can serve as a driving factor for educators in some contexts, its absence can act as a constraint, hindering the growth of teachers' TK, TPK, TCK and TPACK if they lack confidence, and this may lead to their feeling a sense of isolation, and in turn to a lack of a strong sense of belonging in their schools. Practice due to teachers' discontent with certain entrenched rules and customs hindered the teachers' potential to learn TK, TPK, TCK and TPACK in their hybrid CoPs. However, the enhancement of practice, through problem-solving strategies, and the negotiation of meanings through repeated dialogues, were found to be motivating factors that may have fostered the participant teachers' learning of TK, PK and TPK inside their hybrid CoPs. Resistance to change exhibited by older teachers can have a substantial impact on their decision to acquire TPACK from their peers, and this particular attitude may be seen as a constraint operating on the growth of teachers' TK, TPK, TCK and TPACK in their schools, thus in turn affecting their identities as teachers, and preventing them from becoming fully part of the hybrid CoPs formed at their schools. In this case, the findings of this study indicated that the professional assistance offered by the more experienced teachers in terms of number of years to newly employed teachers, helped the latter to gain a sense of belonging (identity) and this acted as a motivating factor for

these newcomers to acquire PK, CK and PCK in their hybrid CoPs. Vice-versa, through learning from the novice teachers, there was a possibility that the more experienced teachers' identities might improve in the process of their acquiring TK from the newcomer teachers. Bonding and bridging provide access for teachers to form relationships that may lead to the approaches and factors that may either allow a smooth acquisition of TPACK or block it. Most interestingly, the findings showed that, if these teachers felt they were not acquiring or increasing important knowledge in their hybrid CoPs, they would opt to bridge to other schools or hybrid CoPs outside of their respective schools to seek the desired information. The findings from this study also suggest that, albeit to a limited extent, educators had bonded with one other throughout the COVID-19 pandemic, and that this ultimately led to the sharing of CK and to mutual emotional support. Significantly, the findings indicate that some teachers in their hybrid CoPs were more inclined to bridge to other schools or other hybrid CoPs and this had led to some teachers' acquiring CK and PK outside of their respective schools. Figure 6. below offers an overview of the research and indicates the current status of its progress.

In the following chapter, the study is assessed and consolidated, encompassing an overview of the research, conclusions drawn, recommendations made, and the limitations encountered during the study.

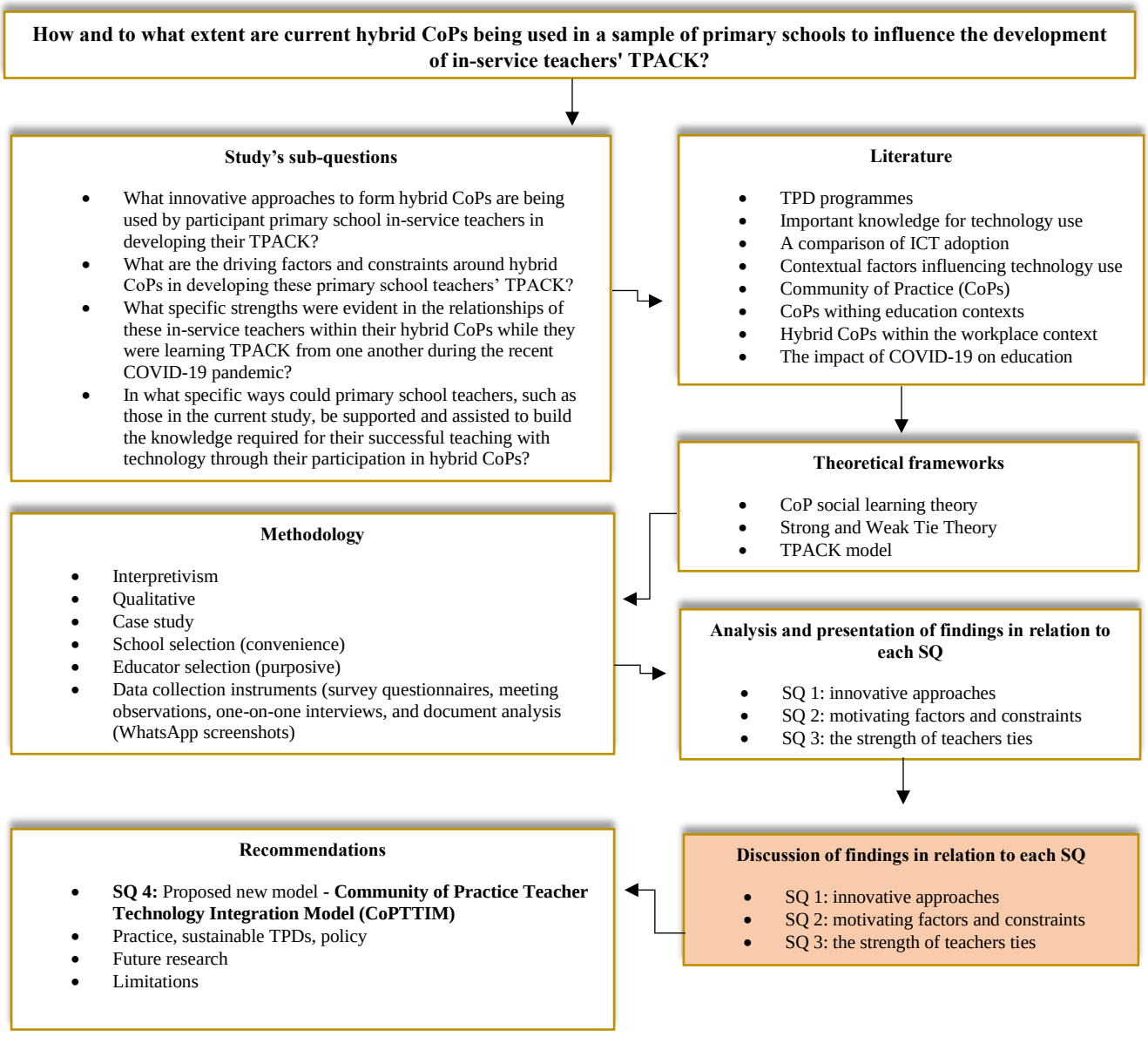

Figure 6.1: An overview of the research and indicates the current status of its progress

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1. introduction

This Chapter 7, as the study's conclusion, offers an overview of the study and summarises the key research findings in relation to each research question and research aim. Additionally, it offers recommendations, discusses the limitations of the study, and offers recommendations for future research. The rest of the chapter has been divided into the following subsections:

7.2. Overview of the study

7.3. Conclusions drawn from the findings.

7.4. Recommendations

7.5. Limitations of the study

7.6. Future research

7.7. Chapter summary

7.2. Overview of the study

The study aimed to understand the influence of hybrid CoPs on the development of a sampled group of primary school in-service teachers' TPACK in a historically disadvantaged area of Khayelitsha in the Western Cape province of South Africa. This study has seven chapters, each addressing a significant facet of the study. Chapter 1 introduced the study by outlining the researcher's personal and professional experiences that prompted the study. The background of the study is explored by offering an understanding of the problem being addressed in addition to the extent to which it affected, and continued to affect, in-service teachers in the Western Cape province. The main research question was formulated as follows: *How and to what extent are current hybrid CoPs being used in a sample of primary schools to influence the development of in-service teachers' TPACK?* The research question was responded to from a perspective of theory as well as practice. The explication of the theoretical perspective required an extensive review of existing literature on the research topic, which was provided in Chapter 2. The review of the literature indicated that many educators use innovative approaches in their establishment of CoPs,

and, in the process, simultaneously acquire valuable knowledge from one other. The theoretical frameworks underpinning this study were introduced in Chapter 3. These frameworks include CoP social learning theory (Wenger, 1998), Strong and Weak Tie Theory (Granovetter, 1973), and the TPACK model (Mishra & Koehler, 2006). The practical aspect of my study included a methodological gathering and analysis of data, with the findings presented in Chapter 5; the subsequent discussion of the findings is presented in Chapter 6. Chapter 4 included a thorough explanation of the methodology used in this study, which involved using qualitative methodology inside an interpretivism paradigm. Data was gathered by means of an open-ended survey questionnaire, one-on-one semi-structured interviews, observations of staff meetings, and analyses of documents (specifically WhatsApp screenshots). Findings were obtained from the analysis of the data using the ATLAS.ti version 23.3.4. The findings of the study, obtained from subsidiary research questions 1, 2, and 3 (see Table 7.1 below), were reported in Chapter 5. In Chapter 6, an in-depth discussion of the findings was presented, taking into account the relevant literature. Chapter 7 concluded the study, offered recommendations and answered subsidiary research question 4 (see Table 7.1) by introducing the Community of Practice Teacher Technology Integration Model (CoPTTIM), which was developed based on the study's theoretical frameworks, the literature review, and the findings in response to the subsidiary research questions 1, 2, and 3 (see Table 7.1 below).

Subsidiary research questions	**Subsidiary research objectives**
What innovative approaches to form hybrid CoPs are being used in developing a sampled group of primary school in-service teachers' TPACK?	To understand the innovative approaches being applied by a group of primary school in-service teachers to form hybrid CoPs in developing their TPACK.
What are the driving factors and constraints around hybrid CoPs in developing the sampled group of primary school teachers' TPACK?	To understand the driving factors and constraints around hybrid CoPs in developing the participant primary school in-service teachers' TPACK.
What was the nature and degree of the strengths of these in-service teachers' relationships in their hybrid CoPs while they were in the process of learning TPACK from one another during the recent COVID-19 pandemic?	To understand the relative strengths of these in-service teachers' relationships in their hybrid CoPs while they were learning TPACK from one another during the recent COVID-19 pandemic.
In what specific ways could primary school teachers, such as those in the current study, be supported and assisted to build the knowledge required for their successful teaching with technology through their participation in hybrid CoPs?	To develop a model, based on the findings, which might be used by other public primary schools to develop and support primary school in-service teachers' TPACK through their participation in hybrid CoPs

Table 7.1: The study's research questions and objectives

7.3. Conclusion drawn from the findings

The study outlines conclusions for each subsidiary research question and provides a conclusion from the findings of the main research question.

7.3.1. Innovative approaches which, through a hybrid CoP, are being used by primary school in-service educators towards developing their TPACK

The study found that the participant teachers engaged in the process of forming hybrid CoPs at their schools were employing both intentional and unintentional innovative approaches. These innovative approaches encompassed several dimensions. Mutual engagement amongst these teachers was enabling teamwork amongst them, and the diverse roles they assumed during this process were contributing to these teachers to acquiring and strengthening their TK, PK and CK. Joint enterprise, arising from a common goal, one which was to successfully deliver lessons and enrich the learning experiences of learners was leading to educators' sharing of TK and PK. A shared repertoire was enabled by the accessibility and user-friendly nature of communication tools, specifically the WhatsApp group chat feature. The discussion of educators' interview responses indicated that during this process teachers were able to learn TK, PK and CK. Additionally, from the analysed and discussed data collected from the WhatsApp screenshots specifically of School C, the study found that educators also share information relating to TK, PK, CK, PCK, TPK, TCK, and TPACK using this communication tool. Relating to the shared repertoire innovative approach, the presence of teaching materials such as MCO and CAMI Maths was found to create the opportunities for teachers to utilise and strengthen their TK, PK, CK and TPK. The discussion of the results suggests that teachers are not sitting around waiting for resources to be handed to them; instead, they're actively seeking out opportunities to collaborate and share knowledge with one another. This proactive attitude is reflected in the innovative approaches teachers use, whether intentional or unintentional. In simpler terms, this implies that teachers show a positive attitude and a desire to learn by welcoming and embracing innovation. This is particularly true considering the new technologies that are facilitating the delivery of curriculum and facilitating communication between these educators. Educators may strengthen their hybrid CoPs via the use of accessible communication platforms, which allows for more collaborative learning experiences and the inclusion of varied educators' perspectives. In addition, this study reveals that hybrid CoPs, by using new innovative approaches, support educators' sustainable and continuous professional

growth. In conclusion, as advocated by Wenger (1998), innovative approaches such as mutual engagement, joint enterprise and shared repertoire have the potential to lead to the formation of CoPs, and in this process, these in-service teachers may also develop their TPACK, which ultimately results in these innovative approaches being important components of contemporary educational practices.

7.3.2. Driving factors and constraints around hybrid CoPs in developing primary school teachers' TPACK

The study unveiled various insights into the factors that either motivate teachers to acquire TPACK in their hybrid CoPs or hinder and deprive them of such opportunities. A sense of community, fostered by structures like ICT committees within schools, was found to motivate some teachers to actively participate in hybrid CoPs, and in the process facilitating the exchange of crucial knowledge such as TK. However, the community aspect also poses challenges, as some teachers reported experiencing feelings of isolation and a lack of confidence, potentially hindering their acquisition of TK, TPK, TCK, and TPACK within the hybrid CoPs at their schools. An implication of this finding is that some educators may experience feelings of isolation due to a lack of school leadership promoting the use of technology for teaching and learning. Consequently, teachers may feel excluded because the school environment does not foster encouragement and inclusivity. This highlights the importance of school principals actively ensuring that teachers feel part of the community by establishing a school-based ICT committee. This committee's responsibilities should include addressing feelings of isolation and boosting confidence in technology integration within the curriculum. Overall, schools and district offices should proactively implement measures to mitigate such negative experiences, ensuring that all teachers benefit from a supportive community. Concerning practice, teachers' dissatisfaction with certain rigid school ICT rules and customs potentially hindered them from acquiring and developing their TK, TPK, TCK, and TPACK in their hybrid CoPs. Yet, when it came to problem-solving strategies, practice served as a driving factor particularly for educators' sharing and developing of TK and PK from one another in their hybrid CoPs. This finding emphasises the necessity for educators to meticulously oversee this form of dual practice to enhance its positive influence. Essentially, it suggests that matters concerning the incorporation of technology into curriculum delivery should not solely fall on the shoulders of the principal or the ICT committee. Instead, fostering a culture that involves other teachers in problem-solving processes may amplify the beneficial outcomes of such practices.

Repeated dialogues within hybrid CoPs motivated teachers by creating and consolidating a sense of meaning and this led to teachers' acquisition and strengthening of TK and TPK. This finding emphasises the significance of open dialogue among colleagues in strengthening relationships within hybrid CoPs. Therefore, I posit that communication serves as the foundation upon which relationships are established and communities are structured (Stănescu et al., 2022) either for the intentional and/or unintentional purpose of teachers' learning of TK, TPK, TCK and TPACK. In terms of identity, personal characteristics such as resistance to change served as a constraint towards teachers' learning of TK, TPK, TCK and TPACK. This highlights the pressing issue of technology underutilisation in South African schools, calling for swift action from national, provincial, district, and school authorities. To tackle this, targeted interventions are necessary, incorporating age-appropriate training and mentoring programmes on TK, TPK, TCK and TPACK while blending hybrid CoP with traditional methods. Notably, teachers' sense of identity, influenced and shaped by the presence of new entrant teachers perceived as more knowledgeable in technology, served as a motivating factor for other teachers' learning of TK. Therefore, the findings of this study emphasise the significance of identity in guiding educators' acquisition of TPACK-related knowledge within hybrid CoPs. Schools can enhance teachers' professional identities by fostering a culture of collaborative learning that recognises the expertise of both older generation teachers and newly employed teachers who recently graduated from university. Taken together, these results suggest that the elements described by Wenger (1998) in his CoP social theory of learning which include community, practice, meaning, and identity were found to serve either as motivating factors and/or constraining factors for the participant teachers to acquire and share TPACK in their hybrid CoPs.

7.3.3. The strength of the primary school in-service teachers' relationships in their hybrid CoPs while in the process of acquiring TPACK from one another during the recent COVID-19 pandemic

This research revealed that, to a limited extent, teachers developed connections with one another during the COVID-19 pandemic's shutdown of schools and partial school attendance in the Western Cape, resulting in teachers' exchanging of information with, and offering emotional support to, one another. In this current study, the discussion of the data revealed that teachers from the three (*n=3*) school (A, B and C) learned CK exclusively inside their in-hybrid CoPs throughout the COVID-19 period. Notably, the findings highlight that when these teachers failed to acquire

crucial knowledge (TPACK) within their hybrid CoPs, they opted to connect with other schools or hybrid CoPs outside their respective schools to obtain information. In this respect the discussion of the findings shows that the bridging of teachers in these three (*n=3*) schools led to teachers acquiring and sharing CK and PK. Importantly, the study found that both bonding and bridging contributed to enhancing innovative approaches, leading to the formation of hybrid CoPs for the development of these in-service teachers' TPACK, albeit to a limited extent. Additionally, bonding and bridging played a significant role in strengthening the driving factors that may have facilitated these in-service teachers' acquisition of TPACK within their hybrid CoPs. Therefore, the study's findings suggest that there was no significant difference in the quality of the relationships formed by these educators during the COVID-19 pandemic. However, given that participant teachers reported acquiring more knowledge (CK and PK) through bridging compared to that acquired through bonding, the latter only resulting in CK learning. This discrepancy suggests that the strength of the strong relationships inside the sample schools during the pandemic was comparatively less, or there was little bonding, prompting teachers to seek more resilient networks outside of their immediate environments. It can be concluded that the educators' relationships in all of the sampled schools were comparatively weaker during the pandemic due to the bridging effect, which leads to the establishment of weak links that facilitate the transmission of significant information. Moreover, the findings of this study confirmed the crucial role of external hybrid CoPs in fostering holistic professional growth. The findings emphasise the proactive function of bridging in addressing knowledge gaps, empowering teachers to access a broad spectrum of perspectives and resources. This highlights the importance for schools to recognise WhatsApp's significance as a valuable tool for connecting educators across different schools. Consequently, it is evident that the use of WhatsApp by educators as a means of communication among themselves serves as a catalyst for the development of strong and weak relationships among themselves as they engage in the process of learning TPACK. This could potentially motivate teachers to make more effective use of the technologies that are available to them in their teaching practices.

7.3.4. The influence of hybrid CoPs on the development of primary school in-service teachers' TPACK

This study found that the presence of hybrid CoPs in the three (*n=3*) selected primary schools influenced the growth of in-service teachers' TPACK (although to a limited extent). As indicated previously, hybrid CoPs were found to influence these teachers' TPACK development mainly through innovative approaches, which include joint enterprise, mutual engagement, and shared repertoire. These innovative approaches highlight the idea that the necessary support for in-service teachers may be found inside their own school, notably from their colleagues, and the surrounding school community. Furthermore, the crucial importance of these innovative approaches emphasises the need for their deliberate adoption in schools to establish hybrid CoPs in order to enhance teachers' TPACK and to promote the use of technology for curriculum delivery. Also, hybrid CoPs were found to influence these teachers' TPACK development through factors such as community, practice, meaning, and identity. The findings of this study indicate that these factors together foster an environment conducive to ongoing learning for teachers, facilitating the acquisition of crucial knowledge needed for effectively delivering their lessons, rather than relying solely on one-time training sessions. While hybrid CoPs do have an influence on the development of in-service teachers' TPACK, the study suggests that they do not fully facilitate TPACK development due to certain constraints. This leads to limited knowledge exchange and acquisition within these hybrid CoPs, primarily in terms of isolated discrete knowledges such as TK, PK, and CK, potentially neglecting the acquisition of TPK, TCK, PCK, and TPACK. Therefore, this study proposes that the factors hindering teachers' learning of TPACK from their peers within hybrid CoPs should be addressed by schools. By doing so, teachers can maximise the advantages of hybrid CoPs and gain crucial knowledge such as TK, TPK, TCK, and TPACK. The study also revealed that bonding and bridging within hybrid CoPs were instrumental in shaping in-service teachers' CK and PK development, especially evident during the recent COVID-19 pandemic. However, evidence from this study also indicates that while crises such as COVID-19 can serve as catalysts for educators to bridge, they may also seek out alternative hybrid CoPs when faced with constraints that hinder their learning of crucial knowledge within their immediate hybrid CoPs. In response to such constraints and in cases of crisis such as the COVID-19 pandemic, the study has led to the formulation of a new model that primary schools could adopt to enhance and cultivate teachers' TK, TPK, TCK, and TPACK in a comprehensive way.

7.3.5. Assisting the primary school teachers in the current study to build the knowledge required for successful teaching with technology using hybrid CoPs.

The study introduced the Community of Practice Teacher Technology Integration Model (CoPTTIM), as described in detail in Section 7.4, with the aim of supporting in-service primary school teachers in acquiring the essential knowledge for effective teaching with technology. The CoPTTIM is specifically designed for use in schools, particularly primary schools, especially those located in historically disadvantaged regions. Its purpose is to enhance and strengthen teachers' TK, TPK, TCK, and TPACK within the context of hybrid CoPs. This model is well-suited to improving in-service teachers' TPACK within their working environment (schools) without disrupting their regular teaching responsibilities. The model comprises several components. Firstly, bonding serves as a foundation for strong ties that may lead to the emergence of innovative approaches within hybrid CoPs. The second component, Knowledge Types and Innovative Approaches, includes TPACK and three innovative approaches: joint enterprise, mutual engagement, and shared repertoire, all three of which may be applied by teachers to form hybrid CoPs while in the process acquiring and strengthening their TK, TPK, TCK and TPACK. The third component, Driving Factors and Constraints, encompasses factors such as community, practice, meaning, and identity that may either motivate or deprive teachers' acquisition of TK, TPK, TCK and TPACK within the context of hybrid CoPs. Lastly, bridging is a component that enables teachers to form weak ties with other schools to seek to acquire an/or improve their TK, TPK, TCK and TPACK when they perceive a lack of knowledgeable educators in their own schools. Taken together, the results of this study suggest that, to fulfil the demands of modern education, the implementation of this model is not only a recommendation; rather, it is an advancement that is necessary, particularly as we transition from the era of the 4th Industrial Revolution (IR) towards the era of the 5th IR. These components are further explained in the subsequent section, 7.4, which focuses on recommendations.

7.4. Recommendations

In this section, the study provides reasons in support of a recommendation that institutions (primary schools) and educators adopt the CoPTTIM into their practices to support the implementation of sustainable TPDs. In addition, the study recommends practical actions that

school districts, school principals, and in-service teachers could undertake to improve teachers' TK, TPK, TCK, and TPACK.

7.4.1. Recommendation for the body of knowledge

Following the presentation of the findings, and a discussion of the study, this chapter outlines the proposed **Community of Practice Teacher Technology Integration Model** (CoPTTIM), guided by the findings of subsidiary research questions one, two and three. The model stands to answer the fourth subsidiary research question: *In what specific ways could primary school teachers, such as those in the current study, be supported and assisted to build the knowledge required for their successful teaching with technology through their participation in hybrid CoPs?* The model was also informed by the selected theoretical frameworks underpinning this study, mainly, CoP social learning theory, Strong and Weak Tie Theory, and the TPACK model.

The CoPTTIM is arranged under the following main sections:

7.4.1.1. The need for a new model (CoPTTIM)

7.4.1 2. The elaborated CoPTTIM and its components

7.4.1.3. Chapter summary

7.4.1.1. The need for a new model (CoPTTIM)

In Chapter 2, Section 2.7, it was observed that the national and provincial education department and metropole district TPD programmes offered in South Africa have not been successful in encouraging and equipping teachers to integrate technology effectively into their teaching. Instead of relying on government-organised courses, teachers have come to depend to a large extent on their CoPs at their schools to acquire the necessary knowledge for using and integrating technology into their teaching practices. This finding is supported by several studies, including those conducted by Mahlo and Waghid (2022; 2023), Mustikawati and Tarwiyah (2022), Wang (2020), and Yildirim (2008). Given the substantial amount of evidence from these studies, I advocate for schools, particularly primary schools, and particularly those in historically disadvantaged regions, would gain from using the CoPTTIM to develop and strengthen their teachers' TK, TPK, TCK, and TPACK within a viable hybrid CoP context. It seems that no such model currently exists, in

particular, one that promotes such hybrid approaches which combine conventional face-to-face with asynchronous online approaches to teacher TPD programmes that occur organically inside schools and do not disrupt teachers' everyday routines. This study revealed that the teachers in the sampled schools were both actively/deliberately and passively/unintentionally using a hybrid method to share important educational knowledge (TK, PK, CK, PCK, TPK, TCK and TPACK) with their colleagues. From this one can assume that teachers do acquire a certain level of such knowledge. For instance, in a formal context and mode, teachers might conduct internal workshops to train other teachers in the use of technology for educational objectives. However, in informal, everyday situations, a common occurrence could be one where a teacher has a technical issue when attempting to incorporate technology into their teaching and seeks help from a neighbouring teacher. This notion is in line with Wenger's (1998) claim, cited in Chapter 2, Section 2.7, that CoPs are common but seldom studied due to their informality and pervasiveness.

It might seem that the model is well-suited to schools with abundant technology, but that is not really the case. The model's adaptability makes it useful in a wide range of settings, even those with limited technologies, such as those that formed the basis of this study's sample. The model's goal is to inspire in-service teachers to make the most of the technology at their disposal, regardless of how much or little they have. The discussion of this study's findings showed that TPACK is not being developed according to any particular model or framework in the schools that were part of the sample. On the basis of my findings, I found that the development of this model to be necessary in the hopes that its use in schools would assist in-service teachers in acquiring the knowledge they need to integrate technology properly and meaningfully into their lessons. To facilitate the organic acquisition of TPACK within teachers' hybrid CoPs, I felt compelled to develop the model primarily in accordance with the ideas of Wenger's (1998) CoP social learning theory. As a complement to the CoPs social learning theory, I have included TPACK model and Strong and Weak Tie Theory. The former provides a framework for assessing relationships between members of a hybrid CoP, or hybrid CoPs, while the latter incorporates all aspects of teacher/teaching knowledge. All the components of the model are shown in Figure 7.1, and each of those components is operationalised in this section.

7.4.1.2. The elaborated CoPTTIM and its components

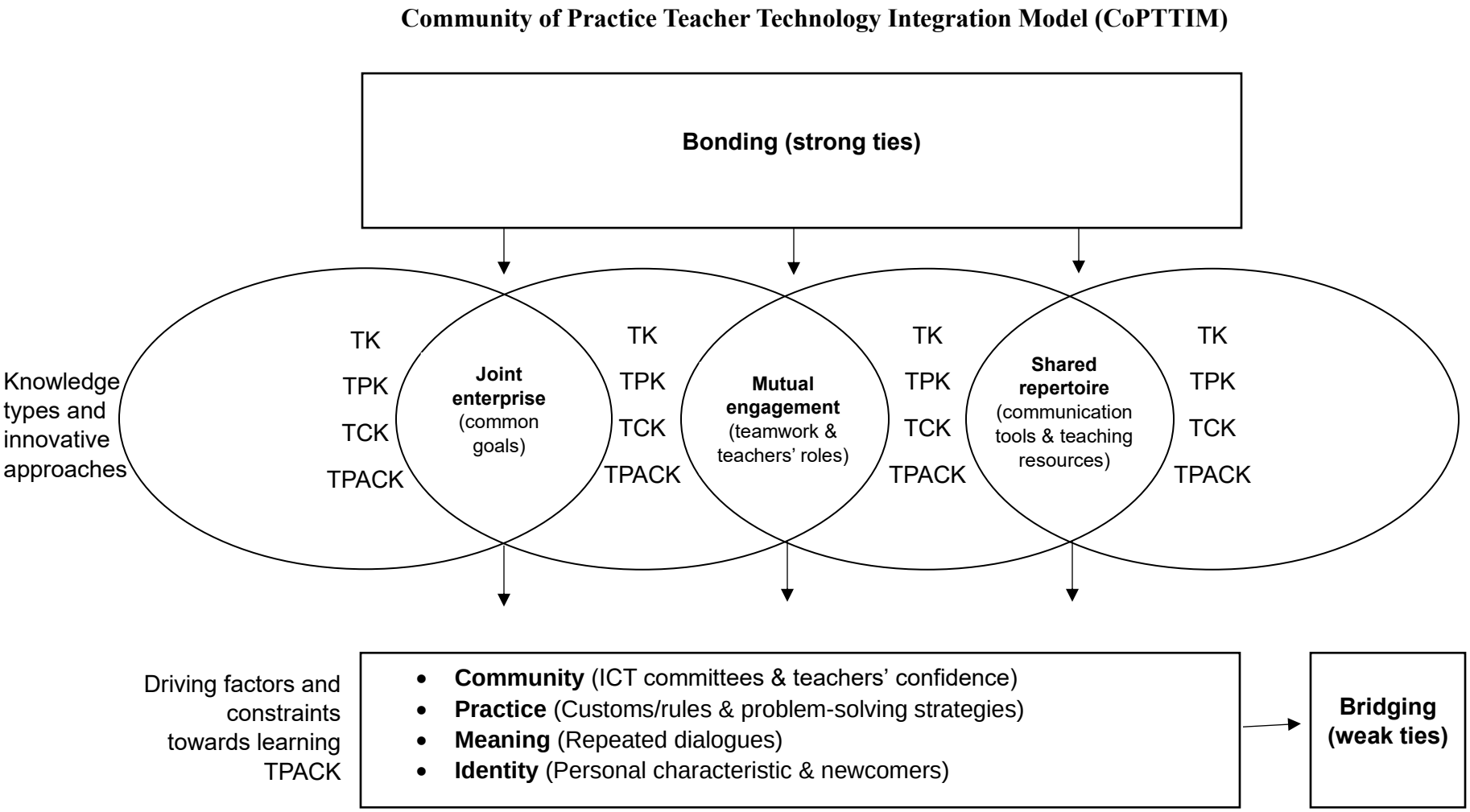

Figure 7.1: Community of Practice Teacher Technology Integration Model (CoPTTIM)

7.4.1.2.1. Bonding (strong ties)

According to Granovetter (1973), as mentioned in Chapter 3, Section 3.3, a network should ideally include a mix of strong and weak ties, since the combined qualities of these ties influence the functioning and composition of CoPs. With reference to the findings of this research, the sampled in-service primary school teachers used bonding connections to create and sustain strong ties in their hybrid CoPs. Strong ties appeared to have a significant influence on the development and enhancement of innovative approaches that resulted in the creation of hybrid CoPs while in the process enhancing teachers' TK, PK, CK, TPK, TCK, PCK, and TPACK. Through the process of bonding, innovative approaches manifested themselves, providing opportunities for teachers to share TPACK. As a result of the bonding component of the CoPTTIM, in-service teachers are encouraged to develop close relationships with one another, and this gives rise to the possibility that innovative approaches may start to emerge. The bonding aspect of the CoPTTIM aligns with the conclusions drawn by Lu et al. (2022) in Chapter 2, Section 2.10. They posit that teachers may establish strong connections with one other by means of bonding. Thus, the CoPTTIM promotes the utilisation of technology for pedagogical purposes in schools by mandating school principals to play a proactive role in creating favourable environments where teachers can foster strong relationships through a collaborative process of setting clear common goals, fostering teamwork, defining distinct roles for educators, promoting the use of online communication tools, and encouraging the sharing of teaching materials as depicted in Figure 7.1 above.

7.4.1.2.2. Knowledge types and innovative approaches

It is important to emphasise that the CoPTTIM only encompasses knowledge connected to technology, namely TK, TPK, TCK, and TPACK. PK, CK, and PCK were intentionally omitted from this model, since its focus is specifically on the essential knowledge that in-service teachers need for them to be able to incorporate technology properly and efficiently into their teaching practices. Furthermore, I considered the notion that in-service teachers are experts in their respective disciplines inside schools, and therefore it is possible that they already possess PK, CK, and PCK. In addition, the discussion of the results in Chapter 6, and the review of relevant literature in Chapter 2, indicate that in-service teachers exhibit a deficiency in TPK, TCK, and TPACK knowledge domains.

The four oval shapes that overlap each other in Figure 7.1 above signify four distinct people who came together to learn TK, TPK, TCK, and TPACK from one another. This is in line with Lave and Wenger's (1991) outline of this process in Chapter 2, Section 3.2. Wenger described a CoP as a group of individuals participating in a cohesive craft or activity. You may think of these ovals as a chain. In between these crossing four ovals are three smaller ovals that represent innovative approaches that hold these four teachers together and lead to the formation of a CoP. Certainly, the hybrid CoP can consist of at least two individuals or members. The inclusion of four ovals in the diagram, each representing a member, doesn't necessitate a minimum membership of four; it simply illustrates that four ovals were chosen to fit neatly and align well within the diagram. This does not imply that every member of a hybrid CoP already possesses some knowledge. It's possible that only a few or even just one member has some form of knowledge, or there might be no one with some form of knowledge. Nonetheless, as argued in Chapter 6, Section 6.6, if schools have access to technologies, educators can collectively learn to utilise them. The findings discussed in this study suggest that introducing technologies into schools before providing teachers with formal TPD sessions could foster collaboration among teachers. Through this process, as demonstrated in the study's findings, teachers can learn some kind of knowledge from each other, informally and collaboratively within their school environments. Without the approaches, CoPs would be deficient or perhaps non-existent. This assertion is also consistent with Wenger's (1998) characterisation of a CoP as a group that is established by means of mutual engagement, joint enterprise, and shared repertoire. This current study's findings, in conjunction with Wenger's (1998) model, suggest that these innovative approaches may take the form of a clear common goal, teamwork, educators' roles, the sharing of online communication tools, and of teaching materials. The acquisition of TK, TPK, TCK, and TPACK also occurs throughout the process of CoP creation due to the ties between the teachers. According to Wenger (2011: 1) in Chapter 3, Section 3.2, it is crucial to consider that learning may either be the purpose of people coming together or it could be an unintended outcome of their interactions. Based on the findings from this study, the CoPTTIM may be applicable in situations where learning is both the reason for, and purpose of, teachers gathering and an unintended outcome of their interactions. Below, I explore the three innovative approaches of hybrid CoPs.

7.4.1.2.2.1. Joint enterprise (common goals)

Regarding both the findings of this present study and Wenger's (1998; 2011) discovery, the presence of common goals is a characteristic that might potentially result in the establishment of a joint enterprise. CoPs are formed by people who regularly connect with each other due to a shared interest or enthusiasm for a particular activity. According to this discovery, it is crucial for school principals to set common goals concerning the use of technology for pedagogical purposes in their schools and to communicate these goals clearly to teachers. This will ensure that teachers do not overlook the significance for their teaching of TK, TPK, TCK, and TPACK, particularly in relation to their learners' academic performance. Both principals and teachers are accountable for adhering to this goal until they successfully accomplish it. In this context the CoPTTIM offers teachers both the opportunity and the ability to set their own goals, and these might turn out to be many shared goals.

7.4.1.2.2.2. Mutual engagement (teamwork and members' roles)

Amongst the findings of this study, teamwork emerged as an essential characteristic of mutual engagement. As stated previously in Chapter 3, Section 3.2.1.1, this result is in line with that of Akinyemi et al. (2019), who found that teachers in their study promoted mutual engagement by means of collaborative learning activities inside their CoPs. Furthermore, this current study's findings suggest that teachers may acquire TK, TPK, TCK, and TPACK from one another by means of bonding, which in turn provide them with a structure for using teamwork which leads to mutual engagement. Thus, in this context, the CoPTTIM would be both valuable and important for promoting teamwork among teachers for them to be able to acquire the knowledge and skills required to effectively integrate technology into their classrooms. Teamwork goes beyond teachers in the same school, which proved to be an unexpected discovery for this current study. It seemed, from the current study, that the teachers were making use of bridging to non-immediate hybrid CoPs. The CoPTTIM promotes the idea that teachers should network with one another, not only inside their own schools but also with teachers from neighbouring schools.

Throughout their involvement in their hybrid CoPs, participant educators' roles were also shown to be a crucial characteristic in fostering and sustaining mutual engagement. These results imply that TK, TPK, TCK, and TPACK acquisition by teachers may be greatly enhanced not only by the involvement of school leaders (principals, deputy principals), but also technologically adept

teachers. This result validates the definition of mutual engagement provided by Jho et al. (2016) in Chapter 3, Section 3.2.1.1: the continuous communication that occurs among community members as well as the roles and relationships that are formed as a direct consequence of this interaction. The CoPTTIM supports these technology-savvy teacher roles, as shown by the findings of this research and those of Baya'a et al. (2019) in Chapter 2, Section 2.7. These teachers may help by providing mentorship to other teachers in the use of technology for pedagogical goals. Technologically savvy teachers may plan and lead internal workshops for their colleagues in their schools in the use of technology in teaching. For example, Tiba (2018) observed in their study, as cited in Chapter 2, Section 2.7, that teachers who were already proficient in technology were eager to provide the kinds of workshops for their colleagues which enhanced education and teacher knowledge and skills. The flexibility of the CoPTTIM allows teachers to choose to bring in outside teachers from nearby schools without having to pay them, which is in line with the argument made by Jho et al. (2016) in Section 2.7 of Chapter 2 based on a case where the school did not have technologically skilled and knowledgeable teachers. in a reciprocal context the favour could be repaid through the exchange of alternative resources. Additionally, it is practical and effortless for educators to seek support from their peers in comparison to having to rely on an external individual or individuals dispatched by the district office.

7.4.1.2.2.3. Shared repertoire (communication tools and teaching equipment)

The results of the current study indicated that the utilisation of WhatsApp group chats and teaching equipment by the participating in-service teachers served to be a significant characteristic contributing to the adoption of a shared repertoire innovative approach. This approach may enable teachers to form hybrid CoPs while simultaneously acquiring knowledge in the areas of TK, TPK, TCK, and TPACK from their peers. In-service teachers showed a clear preference for using WhatsApp group chat as their primary communication tool. Based on the aforementioned finding and on the work of Moodley (2019) discussed in Chapter 2, Section 2.9, teachers can participate in online CoPs using social media platforms like WhatsApp. This allows them to access professional development opportunities with ease, and to acquire knowledge that can improve their teaching in the classroom. The CoPTTIM promotes the use of online communication technologies like WhatsApp for in-service teachers, primarily because of the convenience of being able to access messages at any time and from any location. WhatsApp serves as a simple communication tool for teachers to connect with other schools without the need for

actual visits. They may use WhatsApp to send text messages or form group chats with other schools when seeking information and assistance.

The findings also revealed that the participant teachers shared those educational resources given to public schools by the WCG, including Smart classrooms, Click Foundation programs, CAMI, and MCO. This finding is in line with that of a recent study conducted by Mahlo and Waghid (2022; 2023), as mentioned in the Chapter 2. They discovered that, given their inadequate resources, certain schools in Khayelitsha were promoting a culture of sharing resources. Thus, both this discovery and the CoPTTIM highlight the importance of school districts and principals promoting resource sharing between schools, particularly in terms of hardware and software. This, in turn, has the potential to facilitate or encourage the establishment of hybrid CoPs aimed at enhancing teachers' TK, TPK, TCK, and TPACK. Therefore, schools with few resources for teaching and learning, which is the case with the majority of schools in economically disadvantaged regions of South Africa, make ideal targets for implementing the CoPTTIM. Schools without any kind of technology infrastructure may not be able to use the CoPTTIM.

7.4.1.2.3. Driving factors and constraints towards learning TPACK

As shown in Figure 7.1, the CoPTTIM also emphasises factors that may either motivate or hinder teachers from learning TK, TPK, TCK, and TPACK from one another in their hybrid CoPs. Once a hybrid CoP has been developed using the three innovative approaches mentioned earlier and shown in Figure 7.1, active learning occurs, and it is likely that these factors will also come into effect. It is possible that teachers will either be driven or discouraged to learn TK, TPK, TCK, and TPACK in their hybrid CoPs, depending on the relative impact of these factors. With consideration given to the findings from this study as well as to prior research carried out, these factors, and their ability to motivate or constrain teachers from acquiring these knowledges and competencies, may include social arrangement-ICT committees, teachers' confidence, rules-customs, problem solving strategies, repeated dialogues, personal characteristics-resistance to change, and newcomers. These factors are categorised into the four dimensions based on their characteristics, as described by Wenger (1998) in Chapter 3, section 3.2.2: Community, practice, meaning, and Identity.

7.4.1.2.3.1. Community (social arrangement-ICT committee and teachers' confidence)

A community is a social arrangement that is distinguished by the acknowledgment of the competence of its members in participation and the demarcation of their efforts, according to the definition that Wenger (1998) provides in Chapter 2, Section 3.2.2.3. According to the findings of Shiburi (2021) as highlighted in Chapter 2, Section 2.5.1, and the findings of his research, the in-service teachers who made up the sample in his study regarded school-based ICT committees (comprised of principals, deputy school principals, and teachers) as an essential support structure for teachers who need help with integrating technology in the classroom. The CoPTTIM requires schools to establish support structures to enhance teachers' relationships and encourage teachers to actively improve and refine their TK, TPK, TCK, and TPACK. In addition, in line with the findings of Razzak (2015) and Shiburi (2021) mentioned earlier in Chapter 2, Section 2.5.1, the CoPTTIM proposes that the responsibility of developing school-based ICT policy should be assigned to a dedicated committee within the school that focuses specifically on ICT issues. This committee may have its own WhatsApp group chat dedicated to discussing issues pertaining to the technological equipment in schools. Therefore, the CoPTTIM supports the idea that the presence of social structures like a school-based ICT committee may boost teachers' feeling of belonging within a community. This sense of community can then serve as a motivating towards teachers' TK, TPK, TCK, and TPACK in their hybrid CoPs.

However, according to the findings of this study, the CoPTTIM recognises that a community may also operate as a constraint, to teachers' acquisition of TK, TPK, TCK, and TPACK from each other in their hybrid CoPs. For example, this hurdle might be attributed to the sense of disconnection experienced by in-service teachers in their hybrid CoPs. A thorough understanding of the learning process in a CoP necessitates an examination of the many modes of belonging, including engagement, imagination, and alignment. According to Wenger (1998; 2010) in Chapter 3, Section 3.2.2.3, these modes of belonging may assist community members to build their self-confidence. Thus, the CoPTTIM proposes that the schools prioritise ways to enhance teachers' confidence by helping to provide them with TK, TPK, TCK, and TPACK, and that this may enable teachers to have a stronger sense of belonging in their hybrid CoPs.

7.4.1.2.3.2. Practice (rules-customs and problem-solving strategies)

In light of the findings in Chapters 5, together with the discussion of this study's findings in Chapter 6, the CoPTTIM proposes that rules and customs imposed by school principals as a characteristic of practice, could act as a constraint to teachers attempting to acquire TK, TPK, TCK, and TPACK from their colleagues in hybrid CoPs. Thus, there may be a need for school leaders, such as principals and deputy principals, to establish rules on the use of technology in the classroom in order to ensure that all learners and teachers have equal access to the limited and available teaching resources in schools. For example, it has been shown in both this research and another study by Dube et al. (2018) that teachers' dissatisfaction with rules limits their ability to utilise technology for pedagogical purposes in the classroom. Based on this and other research, the CoPTTIM is designed to promote the idea that school principals need to reach out to teachers and have regular conversations and negotiations with them about the rules that should guide the equitable and easily accessible use of technology in their schools. Teachers need to possess an in-depth understanding of the underlying motives behind such rules in order to readily embrace and comply with them. Based on the current study's results, I argue that the CoPTTIM acknowledges problem-solving strategies as an excellent characteristic of practice that has a strong potential to motivate teachers to acquire TK, TPK, TCK, and TPACK from each other in their hybrid CoPs. Thus, the recently designed CoPTTIM, and the conclusions from prior research (Holland, 2018; Mahlo & Waghid, 2023), indicate the need for a fostering of a school atmosphere that promotes collaborative problem-solving among teachers about the integration of technology in teaching and learning.

7.4.1.2.3.3. Meaning (repeated dialogues)

Teachers' repeated dialogues are a unique characteristic of the process of creating meaning, which might operate as a motivating factor for teachers' acquisition of TK, TPK, TCK, and TPACK in their hybrid CoPs. In relation to the findings of this study, the CoPTTIM suggests that repeated dialogues can be improved by the informal daily interaction among teachers and by establishing a routine where teachers have short meetings lasting 15 minutes or less before the start of the day, or on specific days of the week, to announce urgent matters related to their teaching practice. The model suggests that principal be required to preside over these sessions. In the event that the principal is not available, the deputy principal or a department head may assume the role of

chairperson for these meetings. Furthermore, in accordance with the results of this research, and the geographic area in which it was conducted, the CoPTTIM emphasises the significance of teachers using their mother tongue, Isixhosa for example, as their preferred mode of communication during these short meetings and casual interactions. This discovery aligns with Wenger's (1999) assertion, as cited in Chapter 3, Section 3.2.2.2, where he defines the notion of "negotiation of meaning" as including several facets, including language use. Thus, in this context the adaptability of the CoPTTIM enables in-service teachers to effectively communicate in their chosen languages while engaging both in their informal meetings and in their hybrid CoPs.

7.4.1.2.3.4. Identity (personal characteristic-resistance to change and newcomers)

In line with the findings both of the current study as discussed in Chapter 6, and of the literature (Umugiraneza et al., 2018) in Chapter 2, Section 2.5.4, the CoPTTIM acknowledges that teachers' resistance to change in the context of adapting to new technologies, particularly amongst older generation teachers, represents a negative personal characteristic that may serve as a constraint to certain teachers becoming fully in the use of technology in their teaching and learning. Consequently, this factor may serve as a constraint towards teachers' learning of TK, TPK, TCK, and TPACK in their hybrid CoPs. This may negatively affect their identities, as these older generation teachers may not fully become part of the hybrid CoPs or school community. The flexibility of the CoPTTIM allows teachers to form formalised mentorship programmes in a context where both the mentor and mentee plan an intervention plan together, one that emphasise the relevance and benefits of technology in enhancing teaching practices for all age groups. Also, based on the findings of this study and the literature (Baya'a et al., 2019) in Chapter 2, Section 2.7, the CoPTTIM acknowledges that teachers' sense of identity within a CoP can be enabled by the presence of new entrant teachers (newcomers) who are perceived by other teachers as more technologically knowledgeable, and this strengthening of identity can serve as a motivating factor. The CoPTTIM advocates for schools to take advantage of the newly employed in-service teachers, as they are likely to have more technology expertise than their more senior colleagues. These presence of these newly employed teachers in a CoP has the potential to strengthen other teachers' sense of belonging within their hybrid CoPs. This would develop through these 'novice' teachers by mentoring other teachers in the areas of TK, TPK, TCK, and TPACK. The CoPTTIM advocates for school principals to finally recognise the importance and value of having newly qualified in-service teachers on staff.

7.4.1.3. Bridging (weak ties)

Figure 7.1 shows "bridging" as the final component of the CoPTTIM. Chapter 3, Section 3.3, outlines Granovetter's (1973) explanation of the importance of weak relationships as a "bridging" mechanism that helps people interact across different CoPs. In particular, and based on my findings, the CoPTTIM suggests that teachers from various hybrid CoPs (schools) may form bridges of weak relationships when they collaborate to share resources, ideas, and physical locations. Teachers may choose to bridge knowledge gaps in this way if they are unable to learn TK, TPK, TCK, and TPACK from each other in their immediate hybrid CoPs. The CoPTTIM shows how opportunities can be created for teachers to seek knowledge outside their immediate hybrid CoPs in cases where learning is hindered due to certain constraints as described in section 7.3.3. Crucially, the CoPTTIM serves as a practical framework for schools to enhance their teachers' TPACK, especially under challenging circumstances such as the COVID-19 pandemic. Utilising communication platforms such as WhatsApp enables teachers to share knowledge in an asynchronous manner, regardless of their geographical proximity. It is important to highlight that this does not mean that the bridging approach can or should only be used in situations where there are constraints. The adaptability of the CoPTTIM makes it possible for educators to bridge even in situations where there are no constraints surrounding the formation and strong functioning of hybrid CoPs.

7.4.2. Recommendations for school principals

The study found that in-service primary school teachers were making use of hybrid CoPs to acquire and develop TPACK from one another, although to a limited extent. From this particular case, and similar cases in the literature, it is recommended that school principals promote and endorse peer learning among teachers, in this way eliminating the need for schools to rely solely on government organised TPD programmes, which teachers often perceive as limited. This support can be activated through the designation of technologically proficient teachers to assist their colleagues with technical issues, thus ensuring regular software updates to minimise disruptions. School leadership's sustained encouragement of the use of online forums for teachers to share TPACK, as well as to hold discussions on lesson plans, is crucial to ongoing support of teachers in schools.

The study found that, at times, the rules set by principals were impeding teachers from incorporating available technology in effective ways into their teaching methods. It is important

to acknowledge that these rules were often enforced by principals due to limited resources, rather than to entrenched custom and school culture, in their schools, the aim being equitable distribution of available resources among teachers. However, the study highlights a lack of consultation by principals with teachers before implementing such rules, emphasising the responsibility of principals to inform and seek input from teachers, especially when the implementations directly impact the teachers at that school. Furthermore, the study revealed the absence of school-based ICT policies that could serve as a framework – regularly updated – for technology integration in teaching and learning. This aligns with findings of earlier studies in this area, as cited in Chapter 2, Section 2.5.1, where Mathipa and Mukhari (2014) identified poor leadership and the absence of an ICT policy as hindrances to technology adoption in South African schools. Therefore, based on the findings of this current study, and on previous research, it is recommended that school principals have a school-based ICT policy in place and that teachers should be involved in the design and/or amendment of such policies. A similar suggestion was made by Ojo and Adu (2018), as outlined in Chapter 2, Section 2.5.2, which emphasised the necessity of ICT policies for widespread technology utilisation by teachers. Such policies aim to encourage the use of technology by both educators and learners, particularly in schools situated in socio-economically disadvantaged communities.

7.4.3. Recommendations for in-service teachers

The present study found that, through bonding and bridging teachers were able to form ties that led to the sharing of TPACK, although to a limited extent. Moreover, the findings of the present study appear to suggest that educators from both the sampled schools and other schools in the same region value the assistance they receive from colleagues, whether it be at their own school or in another neighbouring school. Based on these findings, it is recommended that teachers should have regular lesson planning sessions where they discuss ways in which they can include technology in their lessons. They do not necessarily have to always plan with colleagues in the same school but may also do so with teachers from neighbouring schools. This collaboration would provide teachers with opportunities to formulate a broad range of ideas (teaching strategies and TPACK-related resources). In consultation with the principal, teachers and/or school-based ICT committees may organise internal workshops on TK, TCK, TPK and TPACK once or twice a month for teachers who may be in need of such workshops owing to new and – to them – unfamiliar technologies. Naturally, these workshops should be scheduled after regular school hours to prevent

any disruption to the ongoing teaching and learning activities during school hours. In instances where a school lacks a technologically knowledgeable and skilled teacher, it is recommended that a teacher from a neighbouring school be invited to facilitate the workshop.

7.4.4. Recommendations for sustainable TPDs

Previous studies (Chigona, 2018; Graham et al., 2020; Mdingi, 2020) as cited in Chapter 1, Section 1.2 and Chapter 2, Sections 2.1 and 2.4, argued that, despite the widespread acknowledgement of their value, existing government organised TPD programmes in South Africa, such as those initiated in the Western Cape, have come under growing scrutiny for their unsustainability. Thus, this study found that TPDs occurring organically within the working environment of teachers, specifically within schools, hold the promise of sustainability, together with the sustained transferability of urgently need technological skills to teachers. This finding is supported by Mustikawati and Tarwiyah (2022), as previously discussed in Chapter 2, Section 2.7, who found a CoP to be an effective approach that teachers may adopt to increase the effectiveness of their professional development due to the opportunity it creates for them to continuously discuss and support each other in their actions, problems and concerns with others in a group. Considering this finding and findings from existing research, it is recommended that government officials and national-level decision-makers contemplate the restructuring of their TPD programmes to take place within schools, eliminating the necessity for teachers to leave their respective institutions for attendance. In essence, recognising the inadequacies of the traditional approaches towards TPDs, district offices should explore the adoption of a hybrid CoP as a model and method for the development of in-service teachers' TK, TCK, TPK and TPACK; the CoPTTIM may be useful in this regard. This approach not only ensures sustainability but also offers cost-effectiveness by eliminating the need to hire external contractors for the school or district. District officials should facilitate schools in their maintaining of TPD programmes by equipping them with more technologies for teaching and learning. An argument in favour of this would be that the greater availability of resources increases the likelihood of teachers collaborating and utilising these resources. In accordance with the findings of this study, I believe that professional growth, which is active, dynamic, constant, influenced by the teaching environment, and supported by peers in a learning community can be both successful and long-lasting. This concept becomes apparent in research done by Esfijani and Zamani (2020) as explained in Chapter 2, Section 2.1, where they

advocated for TPDs to place importance on cooperation, to be continuous, and to regularly include more effective, practical in-person workshops.

7.4.5. Recommendations for [re]designing ICT policies

One significant change in the ever-changing field of education is the relatively recent use of new technology int classroom instruction. The South African White Paper on e-Education (DoE, 2004) and other national policy guidelines need to be urgently amended/updated in light of this. Given that this policy document was drafted two decades ago, during which period there has been a rapid increase in technological advances, the White Paper on e-Education (DoE, 2004) appears outdated. The educational sector may be in a different place now than it was back then. I thus recommend revising the White Paper on e-Education (DoE, 2004) to include an emphasis on the potential role of CoPs as a sustainable approach to developing in-service teachers TPACK. Incorporating the CoP approach into national policies for sustainable TPDs could influence revisions in provincial and district ICT education policies. The outcome of this might also prompt the mandated formulation of new, pertinent ICT policies at the school level.

7.5. Limitations of the study

I foresaw some challenges that would arise over the course of carrying out this study. I anticipated that these challenges might include several aspects, such as limited time, restricted site access, budgetary limitations, and the complexity of generalising from the findings (Cohen et al., 2007; Creswell & Guetterman, 2019). However, throughout the course of this research, I identified only three specific limitations: the level of trust established with gatekeepers, the lack of response from participants, and the generalisation of the findings.

7.5.1. The level of trust established with gatekeepers

A gatekeeper refers to an individual, authorised or not, who grants entry to a certain location while helping researchers in the process of identifying potential participants (Creswell & Guetterman, 2019:211). Once the WCED granted me formal authorisation to conduct research at their schools, the next task was to gain approval from the specific schools that were intended to be part of the study. To achieve this, I had to get permission from the school principals. Acquiring the principals' permission would naturally provide me access to the teachers. In this particular situation, principals are seen as those who control such access. Due to my prior research experience in the same field,

I strongly believed that some of these schools would be unwilling to grant me permission to do conduct research on their premises. Upon my arrival at School B's reception, the principal informed me, through the receptionist, that the school already had student researchers in place. I then managed to convince the receptionist, explaining the purpose of the research and firmly requesting a direct conversation with the principal. Upon the return from the principal's office, the receptionist instructed me to await the deputy principal's arrival, to whom my request for an appointment had been sent. I subsequently presented the deputy principal with a letter outlining the objectives of the study and followed this with the digital version of the letter. I decided to visit the school on the off-chance that there had not been a response to my emails, given my previous experience with some schools while attempting to collect data for my master's degree.

7.5.2. Lack of response from potential participants

After being provided access to the populations, I personally hand delivered the survey questionnaires to the three (*n=3*) public primary schools and distributed the hard copies to 89 in-service teachers of which only 27 in total completed and returned the hard copies to me when I returned to the schools to collect them the following day. Initially, I had planned to email soft copies of the survey questionnaires to teachers; however, due to the possible disadvantages of emailed survey questionnaires, some of which would include low or non-response from teachers (Cox, 2020), I decided that the paper-based survey questionnaire was appropriate and convenient. To be specific, the rationale behind my decision was rooted in my knowledge of the drawbacks associated with disseminating questionnaires via email, as a significant proportion of individuals often demonstrate non-compliance with the request by failing to complete and return the survey questionnaires. Hence, to mitigate these challenges, as mentioned, I opted to personally deliver the instruments to, and collect from, potential participants at each of the three (*n=3*) schools. With the assistance of the deputy principals of the schools, I was able to secure 27 completed and signed survey questionnaires. Even so, after I identified the four (*n=4*) participating teachers at each school based on their survey questionnaire responses, it was not easy to locate them for interview appointments as sometimes some of them did not answer my calls nor reply to my WhatsApp texts. Again, with the support of the deputy principals, who persuaded some teachers to participate in the study, I was able to interview all of the chosen teachers, a total of 12 across three (*n=3*) schools. Although this approach appeared in the end to work well, it caused a considerable delay in the data collection process.

7.5.3. Generalisation of the findings

When conducting this study, I kept in mind that case studies occur in a unique context in time and location, and that my sample size is smaller than those used in other research methods such as phenomenology and narrative research (Okeke, 2015: 220). As a result, the conclusions of this research can only be generalised to a theoretical stance and/or other comparable contexts, such as other somewhat 'disadvantaged' public primary schools in similar socio-economic contexts. This means that these conclusions cannot be generalised to a range of different education contexts. Since my goal was to have a better grasp of the phenomenon, I was aware of this limitation from the start of the research, and it did not concern me.

7.6. Future research

The study found that the participant teachers were intentionally, unintentionally and making use of their hybrid CoPs to develop their TK, TCK, TPK and TPACK. However, at the time of my study, this was occurring to a limited extent. My development of a model entitled ‘Community of Practice Teacher Technology Integration Model (CoPTTIM)’ represents an attempt to address this gap. It is recommended that future research conduct an empirical study to test the effectiveness of this new model if and when used by schools, teacher training institutions and policy makers. I recommend testing out the model in similar contexts to that in which my study was conducted: in other previously disadvantaged communities in South Africa (which continue to be ‘disadvantaged’ in many ways) or in other countries. Such research and evaluation could provide a clear picture of the extent of the influence of hybrid CoPs on the development of primary school in-service teachers' TPACK, with a focus on schools in previously (and presently) disadvantaged communities.

This study used a multiple case study design. It is recommended that future research make use of a longitudinal case study design, which allows for the examination of a phenomenon over a longer duration, as an alternative to single or multiple case studies. The researcher may go further into the phenomenon by using this form of case study to examine it over a longer period. A more refined and defined model, or models, may emerge from such longitudinal studies that make use of massive data sets. Such studies may help to provide a clearer picture of the extent of the influence of hybrid CoPs on the development of primary school in-service teachers' TPACK, particularly in previously disadvantaged communities.

The study found that it is not apparent how hybrid CoPs had affected the growth of TK, TCK, TPK, and TPACK among the participant educators before and during the recent COVID-19 pandemic. The influence of hybrid CoPs on the development of TK, TCK, TPK, and TPACK among a larger sample of in-service primary school teachers during a crisis, such as the COVID-19 pandemic, could be better understood with a more in-depth study which compares the relative strengths of the relationships in these groups prior to and during the recent COVID-19 pandemic. Such a study might be advantageous for educational systems in the event of future pandemics and other national crises. It could in fact enhance the readiness of global education systems to handle such crises in the future.

7.7. Chapter summary

This chapter drew conclusions from the analysis of the findings outlined in Chapters 6 and 7. The findings responded to the four subsidiary research questions (see Table 7.1 above) and provided insights into the influence of hybrid CoPs on the development of a sampled group of primary school in-service teachers' TPACK. This study found that the presence of hybrid CoPs in the three (*n=3*) selected primary schools had limited influenced on teachers' TPACK development. The hybrid CoPs influenced in-service teachers TPACK development, albeit in a limit way, mainly through innovative approaches which included joint enterprise, mutual engagement, and shared repertoire. In addition, the study showed that hybrid CoPs influenced the participant in-service teachers' TPACK development through factors such as community, practice, meaning, and identity. These factors either motivated and/or hindered these teachers' acquisition and development of TPACK in their hybrid CoPs. Lastly, the study found that, to a limited extent, through bonding and bridging, in-service teachers had developed both strong and weak ties with each other during the COVID-19 pandemic's shutdown and partial school attendance, and this had result in the partial exchange of information with one another, information which included CK and PK. Recommendations are that education districts, principals, as well as in-service teachers enhance teachers' TPACK through hybrid CoPs. Moreover, I advocate for education institutions and educators alike to adopt the CoPTTIM. Figure 7.2 below offers an overview of the research and indicates the current status of its progress.

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APPENDICES

Appendix A: Survey Questionnaire for Convenient Participant Selection

Hybrid Communities of Practice on the development of teachers' Technological, Pedagogical and Content Knowledge

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Note: The purpose of this survey questionnaire is to identify teachers that are involved in hybrid CoPs in their schools. Thank you for taking the time to take this survey. Please respond to each question to the best of your ability. Your thoughts and openness will be immensely appreciated. Your particular name or identifying number will never be linked to your replies. Your replies will be kept strictly private.

Name & Surname: **date:**

Email address: **contact number:**

Grade/s and subject/s you teach (Put an X all that applies)

Grade:

1	2	3	4	5	6

Subject

Maths	**English (FAL)**	**Isixhosa (HL)**

Main questions:

Questions	**Answers**
Apart from workshops organised and conducted by WCED, how did you acquire your technological skills for teaching and learning?	

Would you agree that at your school all educators are united and work as a team? Please elaborate.	

Appendix B: Interview schedule (for teachers)

Hybrid Communities of Practice on the development of teachers' Technological, Pedagogical and Content Knowledge

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Date:

Researcher: **participant:**

INSTRUCTIONS

- Thank you for agreeing to participate in the interview.
- The aim of the study is to examine teachers' experiences in acquiring TPACK in their hybrid CoPs.
- The interview will be taped-recorded, with your kind permission in order for me to grasp accurately what was said.
- The interview session consists 25 questions and will not last for more than 30 minutes.
- All the information you provide will be treated with the highest confidentiality and your name will not be exposed in the research.
- If you require any clarity on any of the questions, please feel free to ask.
- Please answer all questions as honestly as possible.

Research question1: What innovative approaches through hybrid CoPs are being used towards developing primary school in-service teachers' TPACK?

Questions	Notes
1. Describe the feeling of community among teachers at your institution. In this context, the term "sense of community" refers to the common belief that the group's commitment to being together will meet the needs of its members, as well as a sense of belonging and importance among its members. 2. What is your school's teacher culture like in terms of supporting one another when it comes to integrating technology into the classroom? Norms, values, and beliefs are all part of a person's culture. 3. What opportunities do teachers have to cooperate in order to improve teaching and	

learning through technology integration in the classroom? 4. How do you share information with your colleagues regarding the use of technology for teaching and learning? 5. Would you say you have a similar way of teaching with your colleagues? If so, why do you think this is the case? If not, why do you believe this is true? 6. When do you discuss the use of technology with your colleagues as part of your teaching practice? 7. Why are you using technology in your classroom? 8. How do your colleagues influence the way you use technology in your classroom? 9. Do you have the same values with your colleagues regarding the role of technology for teaching and learning? 10. Describe a situation in the last few months when one of your colleagues has suggested a new or different way of teaching a topic or lesson with technology?	

Research question 2: What are the driving factors and constraints around technology integration towards cultivating effective hybrid CoPs?

Questions	Notes

1. What motivates you to use online tools to share information with your teachers? 2. What discourages you from using the online tools to share information with your colleagues? 3. Would you say that you can use these online tools effective to share teaching strategies? If yes or no, please elaborate. 4. Do you share technological teaching and learning tools and knowledge with your colleagues? How and when do you share these resources? 5. What technological tools do you use to share or communicate information with other teachers? 6. What kind of information do you share? 7. Why do you use these particular tools? 8. Do you think these technological tools are helpful? If so or if not, why?	

Question 3: How were the strengths of these in-service teachers' relationships in their hybrid CoPs while learning TPACK from one another during the recent COVID-19 pandemic?

Questions	Notes
1. Before and during the covid-19 outbreak, how were teachers able to acquire the technological resources they needed to teach using technology? 2. How did the relationships between teachers change during COVID-19 compared to before it? 3. How would you describe teachers' bond before and throughout covid1-19? is there a difference? 4. Do you think teachers were assisting each other during Covid-19? 5. What you and other teachers have learnt anything about Covid-19? 6. How was your relationship with other teachers from other schools during COVID-19? 7. How did teachers share information during Covid-19 pandemic?	

Appendix C: Interview schedule (for principals/deputies)

Hybrid Communities of Practice on the development of teachers' Technological, Pedagogical and Content Knowledge

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Researcher: **Date:** **interviewee:**

INSTRUCTIONS

- Thank you for agreeing to participate in the interview.
- The aim of the study is to examine teachers' experiences in acquiring TPACK in their hybrid CoPs.
- The interview will be taped-recorded, with your kind permission in order for me to grasp accurately what was said.
- The interview session consists of 6 questions and will not last for more than 30 minutes.
- All the information you provide will be treated with the highest confidentiality and your name will not be exposed in the research.
- If you require any clarity on any of the questions, please feel free to ask.
- Please answer all questions as honestly as possible.

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1. How would you describe the rate at which teachers use technology in the classroom?

2. How do you communicate/share important information with your teachers?

3. Apart from workshops provided by the WCED, how do teachers gain or develop their technological skills and knowledge deemed necessary for teaching and learning?

4. What role do you play in terms of improving and maintaining the use of technology for teaching and learning by teachers?

5. Do teachers help one another when it comes to the use of technology for teaching?

6. What encourage teachers to work together at your school?

Appendix D: Observation protocol for staff meetings

The influence of hybrid CoPs on the development of primary school in-service teachers' TPACK in a historically disadvantaged area of Khayelitsha in the Western Cape province of South Africa.

Doctor of Education research Date: Time:

School: Meeting venue:

Meeting agenda: Attendees:

1. **Research sub-question one**

What innovative approaches through hybrid CoPs are being used towards developing primary school in-service teachers' TPACK?

1.1. Mutual engagement

What are the driving factors and constraints around hybrid CoPs in developing primary school teachers' TPACK?

2.1. Community (learning by belonging)

Researcher/observer:
Date:
Signature:

Appendix E: Participant consent form

Hybrid Communities of Practice on the development of teachers' Technological, Pedagogical and Content Knowledge

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I _____ (full name and surname) read the Information Sheet and was given information about the research project. My inquiries have been satisfactorily addressed, and I realise that I may ask further questions at any time. I realise that I have the option to withdraw from the research study at any moment and refuse to answer any specific questions. I agree to provide the researcher[s] information with the understanding that my name will not be used without my agreement. The information will only be used for this study and any publications that may result from it. I agree/disagree to the recording of the interview [audio/visual]. I understand that at any moment during the interview, I have the right to request that the recording equipment be switched off. I affirm that I am above the age of 16. I accept to take part in this research study under the terms outlined in the Information Sheet.

By signing here, you acknowledge that:

(1) you have read and comprehended the Participant Information Sheet; (2) all questions about your involvement in this research project have been successfully addressed; and (3) you are participating in this research study freely (without coercion).

Sign: **Date:**

_____ _____

Appendix F: Audit trail schedule

Hybrid Communities of Practice on the development of teachers' Technological, Pedagogical and Content Knowledge

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Name	Contact number	Activity	Location	Date

Appendix G: CPUT ethics approval letter

Cape Peninsula University of Technology

Faculty of Education
Highbury Road
Mowbray
7700
Tel: +27 21 959 6583

FACULTY OF EDUCATION

On the **27 October 2022** the Chairperson of the Faculty Research Ethics Committee of the Cape Peninsula University of Technology granted ethics approval **(EFEC 2-10/2022)** to **L. Mahlo** for a **DEd degree**.

Title:	**The Influence of hybrid Communities of Practice on the development of teachers' technological, pedagogical and content knowledge**

Comments:

The Faculty Research Ethics Committee unconditionally grants ethical clearance for this study. This clearance is valid until **31st December 2025**. Permission is granted to conduct research within the **Faculty of Education only**. Research activities are restricted to those details in the research project as outlined by the Ethics application. Any changes wrought to the described study must be reported to the Ethics committee immediately.

Date: 31 October 2022

Prof. Zayd Waghid

Chair of the Faculty Research Ethics committee

Faculty of Education

efec@cput.ac.za

Appendix H: WCED ethics approval letter

Western Cape Government
Education

Directorate: Research

meshack.kanzi@westerncape.gov.za
Tel: +27 021 467 2350
Fax: 086 590 2282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 16375E04C000028-20230131
ENQUIRIES: Mr M Kanzi

Mr Lebohang Mahlo
54456 Dyakalashe Street
Kuyasa
Khayelitsha
Cape Town
7784

Dear Lebohang Mahlo,

RESEARCH PROPOSAL: THE INFLUENCE OF HYBRID COMMUNITIES OF PRACTICE ON THE DEVELOPMENT OF TEACHERS' TECHNOLOGICAL, PEDAGOGICAL AND CONTENT KNOWLEDGE.

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **31 March 2023 till 31 March 2024.**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Mr M Kanzi at the contact numbers above quoting the reference number.
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Research Services
Western Cape Education Department
Private Bag X9114
CAPE TOWN
8000

We wish you success in your research.

Kind regards,
Meshack Kanzi
Directorate: Research
DATE: 31 March 2023

Appendix I: Letter requesting permission from the school principals

Lebohang Mahlo
54456 Dyakalashe Street
Kuyasa
Khayelitsha
7784
12 April 2023

Dear Principal

Request to conduct research

I am currently affiliated with **Cape Peninsula University of Technology** as a full-time postgraduate student in the Faculty of Education and Social Sciences. The research is in the fulfilment of the **Doctor of Education degree (D.Ed.)**. I am requesting from **Yomelela Primary School** to grant me the necessary permission to conduct my research at the school. The title of my research problem is:

The Influence of hybrid Communities of Practice on the development of teachers' technological, pedagogical and content knowledge.

The research will make use of the Ethnographic case study research to answer the research question. The key research instruments that will be employed to collect the data are:

- Survey questionnaires of teachers who will be approached to be participants in this research, four teachers will then purposefully chosen based on the answers;
- Interviews with four teacher participants (including the school principal).
- Observation (non-participant) of staff meetings; and
- Text analysis of WhatsApp screenshots

My research plan is to at least spend five days at the school, observe teachers' participation during staff meetings, and interview all four teachers (and principal) at any day between the **12th April – 02 May 2023**. This gives me a week (at each school) making a total of three weeks where I will work closely with your teachers. The interviews will obviously be conducted after school hours at any time convenient for educators. The

research will be beneficial to the school and other schools as it may help to improve and increase the use of ICT resources for teaching and learning at the school.

The following ethical safeguards will be followed by the researcher during and after the course of this research project:

- Informed consent in writing will be obtained from the management of the school.
- The right to privacy, and honesty with teachers and principals will be observed.
- I undertake to focus on the research in question and will not interfere in any manner that may jeopardise the integrity of data and the study as a whole.
- I undertake to communicate the objectives, nature and future use of findings to participants prior to commencement of data collection activities.
- Participants will not be placed under compulsion during the research project.
- Informed consent by participants will be a prerequisite in the gathering of the data in this study, this will include assurances of confidentiality and anonymity of the site, organisation, participants and individuals will not be compromised during the research process.
- A copy of the final research report will be given to Yomelela Primary School.

I trust that this information will allow you to make an informed decision with regard to my request. Should you need to contact my supervisors, they are:

Professor Zayd Waghid (waghidz@cput.ac.za) and **Professor Agnes Chigona** (chigonaa@cput.ac.za).

Yours sincerely

Lebohang Mahlo
Student number: 211168971
Email: lebohangmahlo18@gmail.com
Cell: 0714008233

Appendix J: Consent from the school principal

Consent by the principal to conduct research at his/her school

I the principal of the school (Kuyasa Primary School) Mr. / Mrs. / Ms. / Dr. / Prof.

…… give permission to the researcher to conduct a research project and interview and observe educators at the school.

Sign …….. Date: ……..

Signed at……