

**Readiness of senior students to participate in a nursing environment of digital
technology in hospitals in Cape Town**

by

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Thesis submitted in fulfillment of the requirements for the degree

Master of Nursing Science

in the Faculty of Health and Wellness Sciences

at the Cape Peninsula University of Technology

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Date: 15 April 2025

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DECLARATION

I, Randall Elton Louwson, declare that the contents of *Readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town* represent my unaided work and that the thesis has not previously been submitted for academic examination towards any qualification and that all the sources have been indicated and acknowledged by complete references. All the resources I have used or quoted, have been indicated and acknowledged using complete references. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

A handwritten signature in black ink that reads "R. Louwson". The signature is written in a cursive style, with the first letter of "R" being large and stylized, and the last letter of "N" also being stylized.

Signed: Randall Elton Louwson

Date: 15 April 2025

ACKNOWLEDGEMENTS

Glory to The Almighty God! This degree was made possible through Your continuous blessings God, as every milestone in my life is set out according to Your plan, timing, and place! To my family who have supported and encouraged me during this study, a very special thank you to you all! This journey was not easy, but with your continuous love and support, I could close this chapter successfully. I always have you at heart and will continue making you proud of me.

My sincere gratitude and appreciation are expressed to the following people:

- Professor Karien Jooste, my supervisor. Thank you for guiding me during this beautiful and at times, very stressful journey in obtaining my master's degree. Your endless input, expert advice, support, and motivation during my study will always be remembered and treasured. Thank you for being the light when days became dark and difficult to endure. You will always have a special place in my heart.
- Ms. Amy Williams, my co-supervisor. Thank you for your continuous input and support during this study. Many thanks and appreciation for all your feedback and guidance to help me to obtain this degree. Know that I appreciate and value all that you have done for me.
- Dr. Dirk van Schalkwyk (statistician). Thank you for making this journey possible and for assisting me with the statistical analysis of this study.
- Dr. Franci Cronje (editor) for editing my thesis. Your valuable contribution towards making this degree possible is noted and appreciated.
- Mrs. Ursula Mafaro, Mrs. Nazlie September, and Ms. Duduzile Joy Masombuka (my besties and family away from home). Thank you for always believing in my ability to complete this degree. Your support and love as friends during this study always kept me motivated. Love you lots!
- All the nursing students who have participated in the study. A big thank you to you all. Your participation has made this study possible and contributed to me obtaining this degree.

DEDICATION

This dissertation is dedicated to my late parents (William and Annie Louwson). This degree was made possible through all your sacrifices and efforts to provide and ensure the best possible life for my siblings and me. Your sacrifices paid off well, and I know you are both proud of me, even if you are no longer with us. This degree is for both of you. Forever in my heart, rest well.

ABSTRACT

In 2020, the healthcare sector was transformed into a new era called Healthcare 4.0. It is also known as the era of smart medicine, an era brought along by the forthcoming 4IR. Nursing students form a fundamental part of the healthcare sector and in the use of Information Technology (IT) in our healthcare environments. Therefore, it is of extreme importance that these students should be ready for a technology-mediated healthcare environment in the new era of healthcare. They should acquire basic technology skills such as obtaining competence in both the use of patient care technologies and information management systems. However, their readiness to participate in the use of healthcare technologies will have an impact on their future role as a Professional Nurse. A lack of technological knowledge, skills, and positive attitude could affect the quality of patient care expected to be rendered in the new era of healthcare. The study explored and described the readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town.

A non-experimental, descriptive quantitative design was used during this study. A survey with a self-developed questionnaire consisting of 39 items on the willingness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town was utilised by the researcher. The accessible study population consisted of 108 nursing students in their 3rd and 4th years, which served as the total sample of the study. Pretesting of the instrument with six (6) students and five (5) nurse educators was conducted before the main study. All respondents completed a 5-point scale questionnaire in their own time after completing an informed consent form to participate in the study. It took around 30 minutes to complete the instrument that was returned in an enclosed envelope.

Descriptive and inferential statistics included an Exploratory Factor Analysis that indicated the reliability of the instrument through the Cronbach's Alphas (α) of the three factors, with values between 0.766595 to 0.888589. The Pearson Square Test (χ^2) and The Likelihood Ratio Test (refined the Pearson Test and determined the best data distribution given in a specific situation in the data), were conducted using the significance level of $p < 0.05$. Significant differences were found between the responses of the 3rd and 4th year senior students on their *willingness* (defined as readiness) to participate in some of the new digital technological developments in a nursing environment. Validity and reliability were ensured throughout the research

process. Ethical principles, such as the right to privacy, confidentiality, and anonymity, withdrawing from the study, the principle of beneficence, and justice, were followed.

The findings indicated a total willingness of around half of the students on their psychological awareness of a new approach in using Information Technology devices that will require a changed perspective in delivering nursing care. An unwillingness among a third of the students indicated that they were not ready for digitalisation, which would change the traditional methods of nursing treatments. In Factor 1, on the improvement that the role of Information Technology brings to the delivery of effective nursing care, indicated significant differences in the responses amongst the 3rd and 4th years on aspects around the topics of (i) skills development, (ii) social and interpersonal relationships, and (iii) knowledge. In Factor 2, on a new approach in using Information Technology devices that will require a changed perspective, significant differences were found in the responses between 3rd and 4th years on aspects around topics of; (i) psychological awareness, (ii) skills development and (iii) knowledge on Items 25 and 37. In Factor 3, on staff insecurity of their future role in a changing nurse-patient environment, significant differences between the responses of 3rd and 4th years were found on aspects of; (i) psychological awareness, (ii) social and interpersonal relationships, and (iii) knowledge.

The conclusion of this study indicated that despite challenges in adapting to the changing focus of using IT in delivering healthcare, student nurses varied in the extent of their willingness to participate in using digital technology in their practice. As technology continues to grow rapidly in the healthcare sector, it is recommended that nurse educators keep their adopted teaching strategies in both clinical and classroom teaching, on par with the pace at which the use of digital technology is implemented in nursing practices, to complement the learning of nursing students. To meet the demands of the 4IR and other forthcoming industries of the new healthcare era, the researcher recommends that further studies explore the implementation on the use of technology by nurse educators and students in nursing education.

KEYWORDS

Nursing practice, digital technology, senior nursing students, readiness, willingness, academic hospitals

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ABBREVIATIONS AND ACRONYMS

AI:	Artificial Intelligence
AR:	Augmented Reality
BNURS:	Bachelor of Nursing
BTECH:	Baccalaureus Technologiae: Nursing Science
COVID-19:	Coronavirus disease
CPUT:	Cape Peninsula University of Technology
DET:	Digital Educational Technologies
DHTs:	Digital Health Technologies
EMARs:	Electronic Medication Administration Records
EHR:	Electronic health records
E-Rostering:	Electronic rostering
4IR:	Fourth Industrial Revolution
ChatGPT:	Generative Pre-trained Transformer
HEI:	Higher Education Institution
HIT:	Health Information Technology
HIS:	Health Information Systems
HR:	Human Resources
HREC:	Health Research Ethics Committee
HTA:	Health Technology Assessment
ICT:	Information and Communication Technology
IT:	Information Technology
LMS:	Learning management systems
PDA:	Personal Digital Assistant
POPIA:	Protection of Personal Information Act 4 of 2013
RAS:	robotic-assisted surgery (RAS).
RIFD:	Radio frequency identification
SANC:	South African Nursing Council
SD:	Standard Deviation
SPSS:	Statistical Package for the Social Sciences
TR:	Technology Readiness

CHAPTER 1

OVERVIEW OF THE STUDY

1.1 INTRODUCTION

Nursing formed part of the emerging new era of healthcare that was brought along by the concept of the forthcoming 4IR. It is an era in healthcare that rapidly developed and impacted digitalisation using digital technologies in new and unanticipated ways (George, 2024; Jakoet-Salie & Ramalobe, 2023; Popov, Kudryavtseva, Kumar Katiyar et al., 2022). The 4IR involves technological innovations in the fields of automation, the rise of robotics, artificial intelligence (AI), and information technology (Kulkov, Kulkova, Rohrbeck et al., 2024; Apell & Eriksson, 2023; Khogali & Mekid, 2023; Turner, 2022). The 4IR promises to bring exciting opportunities and unavoidable challenges to practice, including the healthcare sector (Samadhiya, Kumar, Garza-Reyes et al., 2024; Stoumpos, Kitsios & Talias, 2023; Hakim, White, Hamdy et al., 2019). Throughout the forthcoming 4IR, human beings with digital skills are becoming more valuable and sought-after assets when competing with robots in a dramatically and fundamentally changed world of work (Perifanis & Kitsios, 2023; Javaid, Haleem, Singh & Suman, 2021; Kupe, 2019). This concept is very related to service-related practices such as in the healthcare sector (Bamel, Talwar, Pereira et al., 2023; Philbeck & Davis, 2018). However, nurses must be ready (willing), thus become fully prepared for these technological changes (Dawson, Fisher & Wiese, 2024; Hallaran, Edge, Almost et al., 2023; Barchielli, Marullo, Bonciani et al., 2021). The field of nursing should be knowledgeable about how successfully technology is used to prepare nurses for delivering quality patient care (Shelley, Davis, Bail et al., 2024; Tsarfati & Cojocaru, 2023).

In this study, readiness referred to the student nurse *being willing* to be part of the forthcoming technological changes due to the new era in healthcare.

In 2020, the healthcare sector transformed into a new era called Healthcare 4.0, also known as the era of smart medicine. This era was brought along by the concept of the 4IR (Detwal, Agrawal, Samadhiya et al., 2024; Laurisz, Ćwiklicki, Żabiński et al., 2023). Nursing Science is one of the healthcare sectors that is most exposed to technological inventions and advancements (Cobelli & Blasi, 2024; Hack-Polay, Mahmoud, Ikafa et al., 2023; Niang, Dupéré, Alami & Gagnon, 2021).

The new brainpower in Healthcare 4.0 consists of important elements such as precision medicine, AI, and telemedicine (Rony, Kayesh, Das Bala et al., 2024a; Cingolani, Scendoni, Fedeli et al., 2023; Chen, Loh, Kuo & Tam, 2019). Nurses are required to come to terms with the growing reliance on IT in their work environment (O'Hara & Reid, 2024; Frennert, Petersson & Erlingsdottir, 2023; Archibald & Barnard, 2018). Developments in IT have worldwide affected the healthcare sector and provide many benefits and advantages to healthcare workers (Chinnakali & Kumar, 2024; Paul, Maglaras, Ferrag et al., 2023).

Some of the technological benefits for nursing are; (i) the beginning of electronic paperless records as a replacement to the standard paper records (Islam, Mim, Tasfia et al., 2024; Madziwa & Masuku, 2024), (ii) the introduction of robotic healthcare to improve high-quality nursing and patient care (Georgadarellis, Cobb, Vital et al., 2024; Ohneberg, Stöbich, Warmbein et al., 2023), and (iii) telehealth technologies to assist in disease prevention and the recovery of healthcare activities (Thomas, Taylor, Ward et al., 2024; Curioso, Coronel-Chucos & Henríquez-Suarez, 2023; McElroy, Day & Bacevich, 2020).

Healthcare technology refers to any IT tools, software programs, or interventions that are used to promote patient health and the prevention, diagnosis, and treatment of acute or chronic illness (Adeghe, Okolo & Ojeyinka, 2024; Amjad, Kordel & Fernandes, 2023). According to Khanuja, Sreedharan and Sharma (2024), Vasquez, Moreno-Lacalle, Soriano et al. (2023), and Milton (2018), the introduction of these forthcoming technological developments especially in the field of nursing is characterised by a blending of disruptive technologies such as cyber-physical systems, cloud technology, cognitive computing, robotic process and AI. This is confirmed by Hoang (2024) and Mahmood, Kim and Chang et al. (2024), who elaborate on certain technologies that will continue to impact the healthcare environment by using digital transformative technologies such as AI, the Internet of Things (IoT), the cloud, big data and mobile data access. As a result, the healthcare sector is affected by digitalisation and transformation in the way which nurses should provide healthcare (Begkos, Antonopoulou & Ronzani, 2024; Kaihlanen, Laukka, Nadav et al., 2023). However, healthcare technologies remain a challenge for many nurses and nursing students who are not familiar with informatics and digital systems (Wong, Brand, Dix et al., 2024; Laukka, Hammarén, Pölkki et al., 2023; Chung, Kim, Whangbo et al., 2019).

According to Khoza, Mabitsela and Nel (2024), Hariguna, Ruangkanjanases, Madon et al. (2023), and MacNevin, Poon and Skinner (2021), technology readiness (TR) is a concept that is characterised by an individual's desire to use new technology. In the healthcare environment, it is expected that nursing students should be able to prioritise and deliver safe and high-quality nursing care in their final year of training (Johari, Ismail & Salleh, 2024; Mrayyan, Algunmeeyn, Abunab et al., 2023; Mlambo, Silén & McGrath, 2021). Therefore, students should be ready to use technology when entering the healthcare environment as newly graduated Professional Nurses to deliver high-quality nursing care (Jadalla, Hardan-Khalil, Dyo et al., 2024; Altmiller & Pepe, 2022; Aggar, Gordon, Thomas et al., 2018).

The uninterrupted introduction of modern inventions and technology in healthcare institutions raised an important question: *“How ready are nurses, including nursing students, to use technology in the new era of healthcare in the forthcoming Fourth Industrial Revolution?”* (George, George & Baskar, 2024; Mohammadnejad, Freeman, Klassen-Ross et al., 2023; Califf, 2018). The same question was raised in this study.

1.2 BACKGROUND

The 4IR can be described as a world where individuals are moving between digital domains and offline reality, with the use of technology to assist and manage their lives (George, 2024; Oosthuizen, 2022; Philbeck & Davis, 2018). According to Marwala (2023), de Castro Sobrosa Neto, Sobrosa Maia, de Silva Neiva et al. (2020), and Xu, David and Kim (2018), people have no control over either technology or the changes and disruptions that came with the 4IR.

The 4IR-related changes resulted in the integration of high-level technologies in the fields of education and healthcare (Adel, 2024; Chalmers, MacKenzie & Carter, 2021; Penprase, 2018). In addition, the concept of the 4IR is considered a threat to unskilled workers or newly graduates such as nursing students, who are at high risk of being left unemployed (Dotsey, 2023; Li, 2022; Schwab, 2019).

While entering the new era of Healthcare 4.0, the nursing profession is experiencing an increase in the use of digital technology in hospitals (Ronaghi, 2024; Haleem Javaid, Qadri et al., 2022).

1.2.1 The history of the different industrial revolutions

The *First Industrial Revolution* occurred from 1760 to 1840 in Europe and America with the invention of the steam engine (Kashiripoor, 2024; Cartwright, 2023; Mohajan, 2021). It was an era characterised by significant economic and technological developments that brought along new production technologies, new means of transportation, and a new factory system (Duignan & Leong, 2023). The nursing profession started following a more organisational management style with a focus on making healthcare staff more productive. It brought a rise in productivity and output and transformed the economic landscapes of Europe and America (Dion & Evans, 2024). However, this revolution had social consequences and led to demographic changes and urbanisation (Feng, 2023). This urbanisation resulted in social setbacks such as the abuse of workers and the occurrence of social inequality and poverty. The social instability resulted in workers embarking on protest actions and led to the cause of political changes (Lijun, 2024).

The *Second Industrial Revolution* (2IR), also known as the Technological Revolution, occurred from 1870 to 1914. It was characterised by the speedy standardisation and industrialisation that happened from the late 19th to early 20th centuries and involved the use of oil and electricity to power mass production (Datta, 2023; Jerath, 2021; Mohajan, 2021). The 2IR was the age of the electronic telegraph, a game-changing invention that led to universal information and communication networks (McGillem, 2023). These inventions increased the demand for skilled workers in these industries (Haleem et al., 2022; Sakhapov & Absalyamova, 2018). During this time, the role of the nurse began to be recognised, and schools of nursing were established (Mlambo et al., 2021; Machon, Cundy & Case, 2019).

The *Third Industrial Revolution* (3IR) occurred in the 1950s and reached its peak in the late 1990s. It was the era of the implementation of IT to mechanize production (Raja Santhi & Muthuswamy, 2023; Bucci, Schwannauer & Berry, 2019; Kodama, 2018). This digital revolution was invented through the implementation of data processing (1960s), personal computing (1970s and 80s), and the Internet (1990s) (Zakari & Yar, 2019).

The delay of access to higher education became more obvious and resulted in an increased campus diversity, globalisation of educational studies, and an increased call for the training of service professionals such as nurses (Mozelius, Cleveland-Innes,

Håkansson Lindqvist et al., 2024; Timotheou, Miliou, Dimitriadis et al., 2023; Coman, Țîru, Meseșan-Schmitz et al., 2020).

The *4IR* occurred at the dawn of the third millennium (beginning of the 21st century) and is characterised by important changes in our lifestyles, work, and how we connect (Marwala, 2023; Oosthuizen, 2022; Xu, David & Kim, 2018). It is seen as a new development of mankind and involves technological developments that are more advanced than those of the previous industrial revolutions (Siekman, Schlör & Venghaus, 2023; Lund, 2021). The technological developments of the 4IR include physical, digital, and biological worlds that generate great promises and potential exposure to danger (Moll, 2023; Pascucci, Savelli & Gistri, 2023; Oosthuizen, 2022; Marivate, Aghoghovwia, Ismail et al., 2021). It creates a person-centered future with opportunities to assist everyone from all income groups and countries (Beres, Underwood, Le Tourneau et al., 2024; Kim, 2023; Oosthuizen, 2022). However, the 4IR also focuses on technological evolution for income rather than well-being (Mayer, 2024; Mbiza & Sinha, 2023; Noble, Mende, Grewal et al., 2022). The focus of this study is on the 4IR revolution.

The *Fifth Industrial Revolution* (5IR) is driven by the developments in data science and big data analytics (Domenteanu, Cibu & Delcea, 2024; Raja et al., 2023; Oosthuizen, 2022; Fanoro, Božanić & Sinha, 2021). There has been an increase in difficulty within these areas since 2017, as AI continues to affect them and navigate us into a new age with technology combined as one overall concept (Aldoseri, Al-Khalifa & Hamouda, 2024). This combination is paving the way for even greater developments (Mhlanga, 2022).

The 5IR (2nd decade of the 21st century) differs from the 4IR because the focus is on shared collaboration rather than competition and possible replacement (Mncwango, Motala, Harvey et al., 2024; Callaghan, 2023; Noble et al., 2022). In the 4IR, the goal is to expand the scope and number of new technologies in business and service environments where people and robots compete for jobs, and the use of technology is rising (Moll, 2023). However, in the 5IR, efforts will be emphasised to understand where each role-player exceeds and can collaborate with technology, rather than one replacing the other (Brunette, 2023; Noble et al., 2022) by focusing on the incorporation of the strengths of humans and machines to achieve shared and

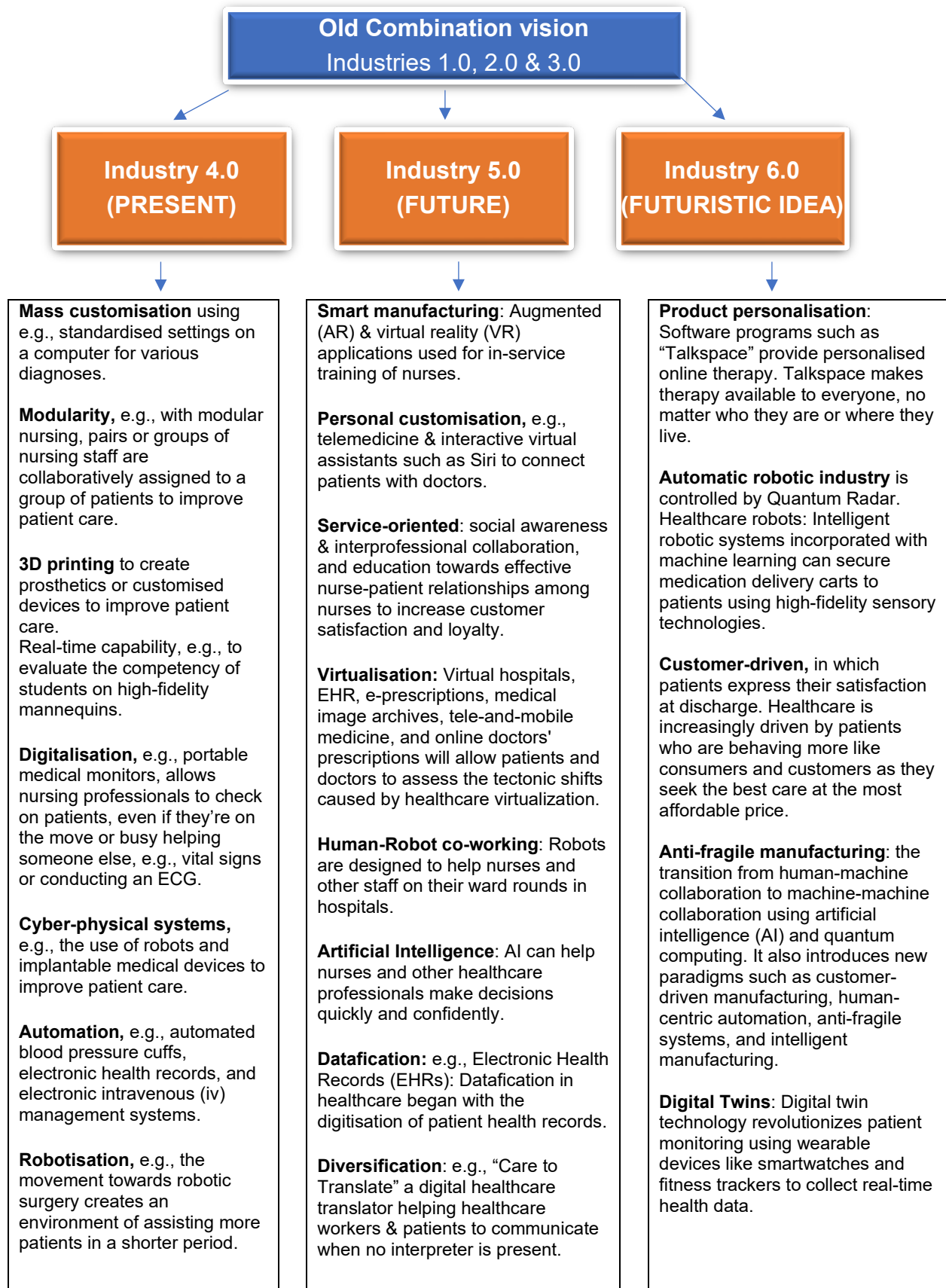


Figure 1.1: Adapted illustration of the visions of Industries 1.0 to 6.0 of Chourasia et al. (2022)

agreeable outcomes for all role-players (Mouazzen, Blomberg & Jaensson, 2024; van den Hout & Davis, 2022). The 5IR will accomplish the well-being of a widespread list of joint shareholders (Oosthuizen, 2022; Fanoro et al., 2021).

Therefore, in this developing transformation, two main factors are likely to shape nursing practices: (1) unprecedented human-machine collaborations, and (2) a strengthened shift towards social well-being.

The *Sixth Industrial Revolution* (Industry 6.0) is a groundbreaking and futuristic concept that will join different thoughts that originate from millions of mindsets (Pereira & dos Santos, 2023; Chourasia, Tyagi, Pandey et al., 2022). All activities will be controlled by the minds of different people, and then applied by automated robots that will disguise all the environmental restrictions. It will join human intelligence, AI, cloud computing energy, human-robot working, big data, and broad computing. It is the mixture of sustainability, anti-fragile objectives, and digitisation that could broadly aid the medical field and manufacturing sectors (Ali & Khan, 2023; Bermejo, Juiz, Cortes et al., 2023). The concept of Industry 6.0 will take 10 to 15 years to be implemented and promote important processing for solving the difficult and massive processes of the present AI models (Carayannis, Posselt & Preissler, 2024; Rahman, 2023; Alojaiman, 2023).

The 4IR poses a challenge for nurses and nursing students and changes the way nursing care is provided (Fields, Dean, Perkiss et al., 2024; Hooper, 2023; Matlhaba, 2023).

1.3 PROBLEM STATEMENT

Change is a familiar aspect in the nursing field. The ongoing technological developments of the new healthcare era may cause even greater changes than what has previously been navigated (Bekbolatova, Mayer, Ong et al., 2024; Subbiah, 2023; Rekha, 2020). According to Knop, Mueller, Kaiser et al. (2024), the use of digital technology by nurses continues to be a huge challenge despite the extensive healthcare developments to date. An ongoing concern is that nurses have mostly not kept abreast of the fast changes in digital technologies and their effect on people. This is confirmed in studies done by Mahmoudi and Moradi (2024), and Booth, Strudwick, McBride et al. (2021a), on how the nursing profession should adapt for a digital future.

The Fourth Industrial Revolution is a reality, yet only a few students have insight into its effects (Alshammari, 2024; Singaram, Meyer & Oosthuizen, 2023; Datta, 2023). Previous research studies have provided clear evidence that IT could improve the work competence of nurses, and benefit patients and the healthcare sector (Shen, Li & Yeh, 2024; Ortega-Lapiedra, Barrado-Narvi3n & Bernu3s-Oliv3n, 2023; Kjellaas, Fredheim & Moen, 2020; Krick, Huter, Domhoff et al., 2019). Nursing is one of the sectors that is the most exposed to new technological inventions and evolution (Rony et al., 2024a; Booth et al., 2021a). Nurses are therefore expected to be aware of all the new healthcare technologies, which can have a magnificent impact on future practices and patient care (Havard, Whistance, Johns et al., 2024; Hallaran et al., 2023; Mlambo et al., 2021; Gegenfurtner, Schmidt-Hertha & Lewis, 2020; Milton, 2018).

The approach to technology in nursing is considered a challenge for many nurses and nursing students, who are not familiar with informatics systems and digital technology (Mohammadnejad, Freeman, Klassen-Ross et al., 2023; Chung et al., 2019). Nurses find themselves in unfamiliar territory, and the questions posed were:

- How ready are senior students to participate in a nursing environment of digital technology emerging from the new era in healthcare?
- How can senior students be supported to participate in the digital changes emerging in the nursing environment, as part of the Fourth Industrial Revolution?

1.4 PURPOSE OF THE STUDY

The purpose of the study was to determine the readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town.

1.5 OBJECTIVES OF THE STUDY

The objectives of the study were:

- To determine the extent to which senior students were ready to participate in a nursing environment of digital technology in hospitals in Cape Town.
- To describe the support given to nursing students to be ready for a nursing environment of digital technology in hospitals in Cape Town.

1.6 METHODOLOGY

The research study was conducted within a positive paradigm in an organised manner, which was aimed at the importance of obvious facts (Chafe, 2023; Park, Konge & Artino, 2020).

1.6.1 Research design

The research design was an outline of methods and techniques chosen by the researcher that combined different elements of research in a reasonably logical manner so that the research problem could be effectively managed (Prediger, 2024; George, 2023; Khanday & Khanam, 2023).

This study followed a non-experimental, descriptive, quantitative design. According to Kosie and Lew-Williams (2024), McCombes (2023), Barroga and Matanguihan (2022), Thakur (2021), and Swart, Kramer, Ratele et al. (2019), the variables can be described in a descriptive research design to answer the research question and to establish the relationship between the variables.

1.7 RESEARCH SETTING AND POPULATION

1.7.1 Research setting

This study was conducted at an academic university of nursing in Cape Town with a nursing student population of N=108, including third- and fourth-year undergraduate students respectively from a phasing-out and newly implemented nursing programme.

1.7.2 Population and sample

Harris, Statler, Montague et al. (2024), Chingwali-Nsanta, Buys, Burman et al. (2023), Bhandari (2022a), and Willie (2022) refer to a research population as the complete group of respondents of interest who meet the criteria of interest of the study. The respondents in this study were all senior students registered in either a phasing out (Baccalaureus of Technology in Nursing) or a newly implemented 4-year Bachelor of Nursing programme at an academic university of nursing in the Western Cape. The research population made up the data pool for the study (Flynn & Rocheleau, 2024; Ravikiran, 2023; Gumpili & Das, 2022), and all the nursing students were registered at the SANC as learner nurses.

The target population in this study was thus all the senior students (N=108) registered at a nursing institution for a 4-year nursing programme at a university in Cape Town.

Senior students referred to 3rd-year-level nursing students in the 4-year Bachelor of Nursing programme (Government Notice No R174 of 8 March 2013), and the 4-year nursing students in the Baccalaureus of Technology in Nursing programme (Regulation 425 of 22 February 1985 as amended). Harvey, van Teijlingen and Parrish (2024); Raifman, DeVost, Digitale et al. (2022), Fetzner (2020), and Majid (2018) define an accessible population as the portion of the target population that the researcher can access.

Sampling is the manner of choosing typical components of a research population for a specific research study (Balance, 2024; De Calheiros Velozo, Habets, George et al., 2024; Nikolopoulou, 2022). A research sample is a group of selected respondents from a study population that is included in a research study (Snyder, 2023; Cash, Isaksson, Maier et al., 2022).

The researcher used a probability sampling method to select the sample. The sample of the accessible population of n=108 respondents served as the total sample described in Chapter 3.

1.8 DATA COLLECTION

After obtaining ethical clearance from the Faculty of Health and Wellness Sciences Research and Ethics Committee, the researcher consulted with the Head of the Department of Nursing Science and two (2) level coordinators of the department overseeing the senior students. The importance of the study and the participation of both 3rd and 4th-year groups were explained to access the potential study respondents.

An instrument with a five (5)-point Likert scale was developed from the literature review with a total of 39 items. Using a scale, the respondents were able to record their perceptions on a continuum (Zarate, Tarconish, Mason et al., 2024; Balwanth & Singh, 2023). Pre-testing of the instrument was conducted with six students (senior nursing students at a neighboring university) and five nurse educators (experts). This was very important to determine if there were any weaknesses in the data collection tool (Jokinen, Pramila-Savukoski, Kuivila et al., 2024; George, 2023; Busetto, Wick & Gumbinger, 2020).

The researcher visited the data collection site (university) on an arranged day to have an information session explaining the purpose, benefits, and possible risks associated with the study with the potential respondents. This process was voluntary, and no

student was forced to participate in the study (Wei & Cao, 2024; Barrow, Brannan & Khandhar, 2022). Upon completion of the questionnaire, the study respondents placed the questionnaires in an envelope (provided by the researcher) that was closed and placed in a sealed box provided by the researcher, who collected them. The data-gathering process will be discussed in Chapter 3.

1.9 DATA ANALYSIS

The Statistical Package for Social Sciences (SPSS) Version 27 was used by a statistician to analyse the data gathered after the collection process. Descriptive statistics were presented in tables and figures, referring to the number of responses, mean values ($\bar{x}$) and standard deviations (SD). Inferential statistics were used by conducting a factor analysis, which determined the dimensions of the phenomenon of interest (Rovetta, Mansournia & Vitale, 2024; Tavakol & Wetzel, 2020; Yellapu, 2018). An exploratory factor analysis (EFA) discovered the relationships between the various items of the instrument (Husain, Aziz, Hussain et al., 2024; Walton, Nazari, Bobos et al., 2023; Scharf & Nestler, 2019). The Pearson Square Test (χ^2) and the Likelihood Ratio Test were conducted to determine significant differences between the responses of the senior students on items, using the significance level of $p < 0.05$.

1.10 VALIDITY AND RELIABILITY

Validity and reliability will be discussed in Chapter 3.

1.11 ETHICAL CONSIDERATIONS

According to Scheytt and Pflüger (2024), as well as Drolet, Rose-Derouin, Leblanc et al. (2023), ethical behavior should be thoroughly implemented when doing research in the field of human undertakings. Ethical considerations are affected by reducing any harm to the study respondents while, in turn, boosting benefits in research (Largent, Joffe, Dickert et al., 2024; Burgess, Rennie & Moodley, 2023; Macdonald, McNeilly & Kelly, 2020). Ethical approval was obtained from the Faculty of Health and Wellness Sciences Research and Ethics Committee (CPUT/HWS-REC-2022H/4) at a University of Technology in Cape Town (Annexure E), and the Head of the Department of Nursing Science in the Faculty of Health and Wellness (CPUT Bellville campus) (Annexure D), where the research study was conducted. The researcher was guided by fundamental ethical principles that are to be discussed in Chapter 3.

1.12 CHAPTER OUTLINE

Table 1.1 Chapter outlay

Chapters	Content
Chapter 1	Overview of the study
Chapter 2	Literature
Chapter 3	Research methodology
Chapter 4	Data analysis and interpretation
Chapter 5	Discussion, conclusion, and recommendations

1.13 SIGNIFICANCE OF THE STUDY

The world, especially South Africa, needs nursing graduates fully willing to fulfill their role as professional healthcare providers in a dynamic and technology-mediated environment. Nurses in the new era of healthcare will be required to have a high level of knowledge and confidence in using technology in their workplace. However, their readiness during their formal training as nursing students to participate in the use of technology will impact their future role as a Professional Nurse. A lack of technological knowledge, skills, and attitude will affect the quality of patient care expected to be rendered in the new era of healthcare, brought along by the forthcoming 4IR.

1.14 CONCLUSION

The overview of this chapter highlights that it is anticipated that all future nursing curricula at Higher Education Institutions (HEIs) will have to include important aspects of technology to prepare them for Industries 5.0 and 6.0. It also implies that all future Professional Nurses must be ready to implement the principles of the forthcoming evolutions. The new healthcare era (current and future) will thus require highly skilled nurses from all categories to be competent in using healthcare technology and delivering high-quality patient care.

CHAPTER 2

LITERATURE

2.1 INTRODUCTION

In research, literature collected and integrated from previous research should be presented in an organised manner (Eyzaguirre & Fernandes, 2024; Chigbu, Atiku & Du Plessis, 2023; Snyder, 2019). Literature is important to the success of the outcome of academic research (Dorais, 2024). The literature chapter can be regarded as an excellent means of blending previous research findings, explaining evidence of a phenomenon such as IT that exists, and identifying and revealing areas in which more research is needed (Klarin, 2024; McCombes, 2023b; Luft, Jeong, Idsardi & Gardner, 2022). There are five important steps when writing a literature chapter, namely to; *(i) search for appropriate literature, (ii) evaluate sources, (iii) identify the different important key aspects, debates, and gaps in theories, and (iv) use a clear structure for discussion* (Chigbu et al., 2023).

As explained by Varsha, Chakraborty and Kar (2024) and McCombes (2023b), literature should be arranged into sections characterised by important key ideas, descriptions, or trends. In the case of a literature review, theoretical literature reviews have more focus on theory, whilst empirical literature reviews focus on original research such as scientific experiments, surveys, and research studies (Rivard, 2024; Olsson, Sentilles & Papatheocharous, 2022; Luft, Jeong, Idsardi et al., 2022). According to Kraus, Bouncken and Yela Aránega (2024), different types of literature are quoted in the literature reviews of theoretical and empirical research. Primary sources refer to theoretical sources, including theories, serials, periodicals, and monographs. Secondary sources, e.g., books, were used in this study. The literature review of this study focused on the readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town.

2.2 THE IMPORTANCE OF A LITERATURE REVIEW IN QUANTITATIVE VERSUS QUALITATIVE RESEARCH

According to Hunziker and Blankenagel (2024), Castillo and Babb (2023), Renjith, Yesodharan, Noronha et al. (2021), Seo, Tang, Roll et al. (2021) and Snyder (2019), the difference between reviewing the literature of quantitative and qualitative studies

is in that when a researcher is using quantitative research, the literature review is completed before the research study starts.

The literature review was conducted before the research, and it focused on the most recent, reliable, and relevant work that could assist the researcher in developing an instrument for the survey conducted (Chapter 3).

In quantitative research, the researcher uses sources that are precise and objective and include measurable data that can be interpreted with statistical analysis (Dehalwar & Sharma, 2024; Franz, 2023; Mohajan, 2021). The aim of quantitative research is the usage of logical thinking to achieve a huge scope of knowledge and understanding of the phenomenon (Hasan, 2024; Pyo, Lee, Choi et al., 2023; Bhandari, 2022b; Noyes, Booth, Moore et al., 2019). This quantitative research study followed empirical reasoning and allowed the researcher to pursue literature on the readiness of senior students to participate in a nursing environment of digital technology.

2.3 DATA SOURCES SEARCHED FOR LITERATURE

A systematic and specific method was used to explore published studies in databases and search engines. The researcher explored academic journals, scholarly books, websites, and encyclopedias available in PubMed Central, Web of Science, Scopus, ResearchGate, SciELO, and Google Scholar. The concepts of the study were used to search for relevant literature. Journal articles were accessed, read, and saved online or printed for critical reading. Most of the selected material used in this study was published during the past five years.

2.4 THE DIFFERENT GENERATIONS, TECHNOLOGY AND REVOLUTIONS

According to Grainger, Liu and Gladman (2024), Majumder, Haque and Razzaque (2023), and Semwal, Whiting, Bajpai et al. (2019), technology has become an important module in healthcare education in the 4IR era.

Therefore, the skills development of nurses has become an important aspect of preparing them for the future digital era (Martzoukou, Luders, Mair et al., 2024; Matlhaba, 2023; Booth, Strudwick, McMurray et al., 2021b). However, trained nurses and nursing students are from different generations, resulting in a comparison that can have a huge impact on how they view technology (Table 2.1).

Table 2.1: Own interpretation of different generations

Generation	Sub-Generation	Century	Timetable	Notable Occurrence
Greatest Generation	G.I. Generation	20th Century	1901 – 1927	- World War II
	Silent Generation		1928– 1945	- World War II - Civil Rights Movement
Baby Boomers	Boom / Hippie Generation		1946 – 1964	- Born after World War II - A 14-year increase in birth rate worldwide
Generation X	Baby Busters		1965 – 1970	- Vietnam War/Cold War
	MTV/Boomerang Generation		1975 – 1980	-The rise of Mass Media and the end of the Cold War
Generation Y	Millennial Generation		1981 – 1996	- Rise of the Information Age - Internet/War on Terror Iraq War
Generation Z	New Silent Generation	21st Century	1997 – 2010	-Internet-and-Digital Globalisation
Generation Alpha			Born after 2000 2013 – 2025	-The first generation of kids who will never know when social media did not exist

2.4.1 Comparison of the different generations and their view on the use of technology

(i) **Greatest Generation**

The Greatest Generation refers to individuals born between 1901 and 1927 (Zlatanova-Pazheva, 2024). Many of them grew up in an era without general electricity, indoor plumbing, or vehicles. However, they have lived through speedy technological progress that drastically affected their lives and society (Klimenko, 2024). World War II also increased technological developments such as radar, sonar, and improvements in air travel. This cohort represented a big majority of World War II soldiers. These individuals range in the age group of 97 to 123 if they are still alive.

Technology developed very slowly on the customer level during the 20th century. For many individuals of the Greatest Generation, radio was the first technology that came into their homes (Loos & Ivan, 2024). It was an exciting period when families would meet around their radios and make it a shared experience. They are from a generation concerned about communication and social interaction and are bothered by the distractions around us due to technology. However, they also feel that not all technology is good or bad, but instead that, in many ways, technology is a remarkable development and tool. They also acknowledge that due to technology, their lives have been lengthened by the latest medical advancements. This generation is concerned about the fast acceptance and use of technology among the youth, consuming time.

(ii) Baby Boomers

Rota (2024) thinks that Baby Boomers are individuals who were born between 1946 and 1964 and belong to a generational cohort that was born after the end of World War II. Gamaliel (2023) defines generational cohorts as categories of individuals with unselective behaviors and characteristics that were shaped by historical happenings during important stages of their life cycles. All individuals have four life cycles, including youth, adulthood, midlife, and elderhood (Tia, Cosma & Borza, 2024). Historical events during important stages of a life cycle shape a person's view of how they perceive the world, identity, and value systems. Baby Boomers are generally workaholics, nonbelievers of authority, social activists, adventure seekers, enquirers of authority, and lifelong learners (Kelle, Simonson & Henning, 2024).

Arras-Djabi, Cottard and Shimada (2024) state that a general misunderstanding of Boomers is that they lack an understanding of how to apply technology. The universal growth of radio, television, mobile phones, personal computers, and the Internet have all been introduced by Boomers (George, 2024). However, the link between technology and Boomers is very different from other generations. According to Tia et al. (2024), the values and viewpoints of the Boomers on technology were shaped before the rebellion and dependency on the use of technology in daily life. Unlike other generations, Boomers are using technology to help create their desired lifestyle opposed to allowing technology to shape their lives (Luttrell, Harpin, Reville et al., 2024).

(iii) Generation X

Generation X individuals were born between 1975 and 1980 and belong to the generational cohort that understands the value and potential of digital technologies

(Witcher & Sasso, 2022; Thomas, Nair, Benny et al., 2024). Gen X individuals can communicate and collaborate with Baby Boomers (often suspicious or opposed to digital transformation) and Millennials (considered a generation excited or dependent on digital transformation). They have also contributed to shaping ethical and social outcomes of digital transformation, including privacy, security, diversity, and democracy (Lissitsa, 2024).

Gen X individuals are seen as a generation that formed the digital transformation by being innovative, flexible, and influential (Kaleem, Azeem, Idrees et al., 2024). Gen X is the first generation to experience and navigate the digital world and were early adopters and influencers of digital media and culture (Salman, 2024). They embrace the internet as a platform for self-expression, creativity, and engagement. According to Loos and Ivan (2024) and Fisher (2024), Generation X creates and utilises different forms of online content such as blogs, podcasts, memes, and viral videos. They participate in online groups such as forums, chat rooms, social networks, and gaming platforms.

(iv) Generation Y

Generation Y individuals, also known as millennials, were born between 1981 and 1996 and grew up with technology as they were the first cohort to be greatly exposed to it during childhood (Andolina, 2024). This early exposure to technology has notably influenced their preferences, behaviors, and decision-making practices. Millennials have integrated technology into different parts of their lives, such as communication and learning experiences.

Generation Y individuals grew up combining sports with technology and perceive digital tools as helping to improve their athletic skills. A main foundational characteristic of Gen Y is the early and continuous exposure to technology, which has both benefits and disadvantages in terms of reasoning, emotional, and social outcomes (Chee, 2023). Generation Y is the first generation to have uninterrupted access to the Internet and mobile phones, making them highly tech-savvy and skilled at using digital technologies. This generation is growing up with continually developing technologies that influence their behavior and enhance their decision-making skills (Faganel, Pačarić & Rižnar, 2024).

Kalariya, Chauhan, Soni et al. (2024) state that social media plays an important role in shaping the consumer choices of Gen Y. These millennials were raised during the

digital era, where they accepted and used different music technologies. Technology is integrated into their daily lives and offers many opportunities for children with difficult communication needs to use and enhance their communication skills.

(v) Generation Z

Generation Z, also known as Gen Z, consists of individuals born from 1997, with the eldest Gen Z being 25 years old (Shafiq, Ali & Iqbal, 2024; Mishra, Sharma & Garg, 2024). Their world consists of ongoing connections to technology, forming a universal view of IT being practically used in their lives. Gen Zs never knew a time when people did not have ongoing access to the internet. As a result, they expect exclusive information, streaming entertainment, and immediate communication in almost every stage of their lives. Their high level of comfort with technology will eventually make them the most digitally complex generation ever. Gen Z is the first generation to have 24/7 internet access, linked devices, and social media (Andolina, 2024; Dolot, 2018).

Gen Zs use technology for everything, such as online chatting with friends and learning how to develop new digital skills. The recent COVID-19 lockdowns, including social distancing and health-related concerns, drove Gen Zs to pass their time online looking for inspiration, companionship, and meaning.

(vi) Generation Alpha

Generation Alpha is the demographic cohort following Gen Z, and includes children born after 2010 (Chan, 2023). According to Howarth (2023), Generation Alpha is the first generation not to know a time when social media didn't exist. Gen Alpha is far more technically grasped than any generation before them. They include the youngest people in the different generation groups, and the first group born in the 21st century. They are the first generation born to parents who grew up with the internet, cell phones, tablets, and social media (Paulus, Joas, Friedmann et al., 2024; Chan, 2023). According to Brito (2023), Gen Alphas are open-minded when making decisions and controlling their digital identities. Gen Alpha (individuals who have turned 11 years old in 2024) have strong expectations that their personal needs and likes must be considered (Jha, 2020).

The attitudes of current nursing students and their willingness to use technology in healthcare institutions may influence them to have adequate competencies in information systems and learn more about computer systems (Cruz-Barrientos, Carmona-Barrientos, De-la-Fuente-Rodriguez et al., 2023). Therefore, it can be

interpreted that nurses need different skills development sessions (Mlambo et al., 2021). The 4IR and other forthcoming industrial revolutions are posing a challenge for nurses, including nursing students, and it is foreseen that inevitable changes in nursing care will transpire (Hooper, 2023; Morris, 2019).

2.5 AN OVERVIEW OF THE MAIN TRENDS IN THE INDUSTRIAL 4TH REVOLUTION AND THE PREPAREDNESS OF NURSING STUDENTS

2.5.1 The impact of technological developments

Technological developments will continue to change the medical field and have both benefits and challenges (Moore, 2023; Abid, Mohd, Ravi Pratap et al., 2022). The changes in digital technology such as electronic recordkeeping that will provide patients with more access to their health information, will benefit many communities and healthcare settings (Koebe & Bohnet-Joschko, 2023; Keshta & Odeh, 2021; Yang & Gu, 2021). By making use of the latest healthcare developments like telehealth and electronic recordkeeping, nurses will be able to attend to their patients more capably (Panda, Dash, Mishra et al., 2023; Billings, Ching, Gkofa et al., 2021).

Technology became an important element in healthcare education (Paul et al., 2023; Haleem et al., 2022; Semwal et al., 2019). The digital revolution is growing at an inevitable speed with the ongoing introduction of technological inventions, including those in healthcare (Paul et al., 2023; Reis & Melão, 2023; Knell, 2021). Healthcare professionals need to use digital technology for groundbreaking solutions to improve healthcare delivery and to improve the treatment of medical complications (Paul et al., 2023; Bajwa, Munir, Nori et al., 2021). However, the inability to use digital technologies makes nurses feel unsafe and demotivated when new technologies are introduced (Livesay, Petersen, Walter et al., 2023).

The use of technology in *nursing education* makes learning fun and exciting for nursing students (Fealy, Irwin, Tacgin et al., 2023). Technology-mediated learning environments refer to settings where students are making use of Information and Communication Technology (ICT) devices and software tools (Mukumba & Shambira, 2022). Studies by Nojima, Nishino and Martinez (2023), and Harerimana and Mtshali (2019), confirm that technology-mediated learning environments can be very useful to students when combined with the correct pedagogies. In technology-mediated

learning environments, digital technology tools refer to laptops, smartphones, and computer-based applications that support the engagement of students to gain new knowledge, skills, and attitudes (Shirmatov & Akhmedova, 2024). However, there are still challenges facing nurses in the use of digital technology in the education and healthcare sectors. Some of the challenges are; (i) security and safety of personal information, and (ii) the lack of face-to-face interaction with nurse educators facing the optimum use of technology in teaching and learning (Madlala & Mvandaba, 2023; Gause, Mokgaola & Rakhudu, 2022; Williamson & Muckle, 2018).

Important developments were pointed out in literature around nursing practices and the 4IR that focuses on; (i) the psychological aspect of using digital devices, (ii) skills development needed for this era, (iii) the effect around social and interpersonal relationships, and the (iv) need for knowledge on the use of digital devices.

2.5.2 Psychological challenges of nurses on the use of digital devices

The growing reality of AI, robotic methods, and the increasing dependence on telehealth and other virtual healthcare programs are a few examples of the daunting developments brought along by the digital era in healthcare (Al Kuwaiti, Nazer, Al-Reedy et al., 2023). In the field of nursing, technological developments are characterised by changes that can be linked to psychological challenges experienced by nurses (Kim, Lee, Choi et al., 2023; Kulkov, Ivanova-Gongne, Bertello et al., 2023; Barchielli et al., 2021; Pepito & Locsin, 2019).

The attitudes of nursing students and their willingness to use technology in healthcare institutions influence their successful gaining of information skills, and learning about computer systems (Tsarfati & Cojocar, 2023; Bester, Smit, De Beer et al., 2021; O'Connor & Andrews, 2018). The lack of technical knowledge and technological understanding pose challenges to deliver quality healthcare and most likely, to the safety and quality of patient care (Renukappa, Mudiya, Suresh et al., 2022). A quantitative study done by Coopasami, Knight and Pete (2017) at a local university in Kwazulu-Natal, South Africa, measured the psychological equipment and technological readiness of nursing students. The findings of this study point out that although students were psychologically ready for e-learning, they lacked technological and equipment readiness.

The lack of technological readiness of students is also confirmed in studies done by Wagiran, Suharjana, Nurtanto et al. (2022), Lukose, Kantore and Fosu (2021), Mafunda and Swart (2020), and McDonald, Boulton and Davis (2018), using E-learning in South African rural universities. Studies by Bester et al. (2021), and Harerimana and Mtshali (2020), at selected South African universities, found that nursing students have a positive perception of the role of technology in nursing education although they are not ready to use digital devices.

A quantitative study by Al-Hail, Zguir and Koç (2023) among nursing students, assessed perceptions and educational needs regarding digitalisation in HEIs. The findings provide an understanding in terms of the readiness and preparedness of students to participate in online teaching and learning of HEIs. Recommendations of the study highlight the importance of increasing blended learning by using the correct grouping and combination of technology, pedagogies, and the demanding developments of learning in the digital era.

Technology will severely influence the nursing profession as we enter the new healthcare era (Bailey, 2023). The occurrence of new technologies such as virtual care and telehealth requires new roles and responsibilities for nurses in the new healthcare era (Bayuo, 2024). However, some HEIs do not have the foundation to embrace these technologies which make nursing students feel insecure and discouraged when new technologies are introduced (Livesay et al., 2023). To overcome the feeling of uncertainty and dismay among nurses, HEIs must develop ICTs that will control the forthcoming changes in the nursing education sectors (Ataro, Addisie, Hardido et al., 2024; Teixeira, Cardoso, Oliveira et al., 2023; Kleib, Nagle, Furlong et al., 2022; Singh, 2021).

The digital transformation of healthcare includes changes related to the internet, digital technologies, and their connection to new and best care options for better health management procedures (Nygren, Lundgren, Bäckström et al., 2023; Mhlanga & Moloi, 2020). An example of digital transformation in healthcare is the latest software platform ChatGPT. ChatGPT is an artificial intelligence-based chatbot that uses deep learning techniques to generate natural language texts (Aslani & Jacob, 2023; Tran, 2023; Chakraborty, Pal, Bhattacharya et al., 2023; ChatGPT, 2022). According to Abrahams, 2023; Temsah, Aljamaan, Malki et al. (2023), ChatGPT can improve the

success and future health outcomes for patient care in healthcare settings, although there are rising concerns about its safety (Choudhury, Elkefi & Tounsi, 2024).

Nurses are trusted with patients' personal and healthcare information, giving them legal and ethical accountability to always protect such important information (Abuhammad, Alzoubi, Al-Azzam et al., 2020). Compromising the personal information of patients by using AI tools like ChatGPT, might influence the nurse-patient relationship and therefore could create doubt in the healthcare settings (Scerri & Morin, 2023). According to Chang, Yang, Jen et al. (2024), Chang, Liu, Zhao et al. (2024) and Abdulai and Hung (2023), ChatGPT can be programmed toward the learning, reasoning, and solving of problems that copy the human reasoning. However, the use of ChatGPT may not be able to identify or resolve nursing problems that need knowledge, critical thinking, understanding, and personal judgment (Bhaskar & Rana, 2024). Concerns are that ChatGPT might not be able to store human emotions such as empathy and compassion which form part of the important fundamentals of the basic discipline of nursing (Anagnosti, Dourakis, Dimitra et al., 2024; Raustøl & Tveit, 2023). Therefore, it is important to ensure patient-centered nursing care that focuses on compassion, empathy, care, respect, and dignity for all patients (Moudatsou, Stavropoulou, Philalithis et al., 2020).

ChatGPT can assist nurses with their understanding of difficult insights by breaking down difficult ideas into easier and more understandable sections (Haleem, Javaid & Singh, 2024; Tran, 2023; Zhang, Pei, Zhen et al., 2023). The practice of *creating content* using ChatGPT reduces the ethical value of integrity in nursing which calls for nurses to be honest with themselves, their patients, and other healthcare members (Abdulai & Hung, 2023). Nursing decisions include ethical and value judgments. According to Castonguay, Farthing, Davies et al. (2023), Miao and Ahn (2023), and Alkhaqani (2023), the reliance on the use of ChatGPT in nursing education, may produce nurses with less loyalty to ethical values, little or no sense of trustworthiness and pride in managing difficult situations.

The use of ChatGPT in healthcare poses ethical issues that could challenge the essential values of the nursing profession when integrating AI in nursing research, education, and practice that may have potential benefits for the profession (Chang, Ansari & Arami, 2024; Haltaufderheide & Ranisch, 2024; Abdulai & Hung, 2023). The

security issues around the use of ChatGPT could have a negative influence on the education sector. It is seen as a direct danger to the academic integrity of nurse educators in the healthcare environments, a threat that could create a teaching environment of stress and insecurity (Dempere, Modugu, Hesham et al., 2023; Alkhaqani, 2023). The latest example of digital transformation technology is Deep Search AI. Deep Search has an “*agentic capability*” that directs multi-phased research on the internet for difficult tasks (High, 2025). AI assistants like ChatGPT are standards-based and cannot act independently, while agentic AI like Deep Search will be empowered to do more on our behalf (Casheekar, Lahiri, Rath et al., 2024). It achieves in minutes what would take a person many hours. Deep Search works independently, and when given a prompt, can control reasoning to search, interpret, and analyse huge amounts of text, images, and PDFs on the internet (Chaturvedi, 2025).

The insecurity around the possibility of being replaced by robotic nursing care in the future may result in mental conditions such as depression among nursing staff (Ibuki, Ibuki & Nakazawa, 2023; Soriano, Yasuhara, Ito et al., 2022). Although nurses continue to use digital technologies in healthcare settings, it continues to remain a challenge despite the widespread developments to date. An ongoing challenge is that nurses have not kept track of the fast changes in digital technologies and their effect on people (Alenezi, Alshammari & Ibrahim, 2024; Chen, Ding & Wang, 2023; Kavanagh & Sharpnack, 2021). This challenge lessens the possible benefits technology may bring to nursing practice and patient care.

Technological innovations in nursing have led to many changes (Wang, Tang, Liu et al., 2023; Ahmed, 2019). While certain forms of technology may have made positive changes that could lead to job satisfaction in the nursing profession worldwide, there is evidence of the negative aftermath of technology and its exploitation as well (Barchielli et al., 2021; Faulconer, Griffith & Gruss, 2021). Nurses need to experience job satisfaction at a level where they feel secure and valued, and in return, have a positive influence in their workplace (Al Ahmari, Al Qannass, Govallen et al., 2023).

2.5.3 Skills development needed for the 4IR and future industries

According to Santric, Scotter, Bruno-Tome et al. (2024) and Boniol, Kunjumen, Nair et al. (2022), nurses form the biggest part of the universal healthcare workforce. Not only

do nurses provide patient and nursing care, but they also support the families and communities of patients. Nursing is a rapidly growing field, and the role of nurses is becoming increasingly difficult with the ongoing introduction of technology (Pereira da Veiga, Lima de Moraes, Gonçalves Marques et al., 2024). Technological developments in the healthcare sector produce many new changes, such as telemedicine, electronic health records, and advanced medical devices. Therefore, nurses must become proficient in using these new technologies to improve patient care, efficiency, and outcomes (Gala, Behl, Shah et al., 2024; Chereka, Demsash, Ngusie et al., 2022). The introduction of healthcare technology is not only changing the role of nurses to become more specialised but is also transforming the way nurses work and the care they provide. These specialised roles require advanced education and healthcare training, making nurses an asset to any healthcare facility (Glarcher & Vaismoradi, 2024; Graebe, 2024; Lau, Siah, Loh et al., 2023; Sharma, Kalal & Ritu, 2021).

The *skills development* of nurses is therefore important in preparing them for the 4IR and other future digital healthcare eras (Suchkov, Scherman, Bonifazi et al., 2024; Matlhaba, 2023; Mlambo et al., 2021). The clinical skills of nurses are directly affecting the quality, safety and competency of their nursing care for all patients (Cadorette, McCurry, Letourneau et al., 2024; Mrayyan, Algunaee, Abunab et al., 2023; Mlambo et al., 2021). Studies conducted by Pedregosa, Zabalegui, Fabrellas et al. (2024), Anyango, Adama, Brown et al. (2024), McGarity, Monahan, Acker et al. (2023) and Sun et al. (2023), reveal that nursing programmes especially in clinical nurse education, are not effectively preparing nursing students for the demands of working as a professional registered nurse in a healthcare environment of technology. The increase in technology-mediated learning environments is important to guarantee that nursing students gain the necessary *knowledge*, *clinical skills*, and *attitudes* for the use of healthcare technology (Irwin, Hanson, McDonald et al., 2024; Alshammari & Alenezi, 2023; Harerimana; Chang & Cho, 2022; Mtshali, 2019). These three characteristics could be a pre-requisite for their future roles as Professional Nurses (Matlhaba, 2023; Alshammari & Fayeze Alanazi, 2023; Nuuyoma, Lauliso & Chihururu, 2023; Gause et al., 2022; Ngusie, Kassie, Chereka et al., 2022; Smit, De Beer & Myburgh, 2021; Bøe & Debesay, 2021).

Healthcare technologies in the clinical and learning environments are creating many benefits such as the development of *specific skills* in using digital technology (Ghafar, 2024; Stoumpos, Kitsios & Talias, 2023; Yogesh & Karthikeyan, 2022; Abid et al., 2021). Clinical skills refer to any detailed or *specific* nursing care, such as vital signs monitoring, the collection of clinical data, and the administration of medication that has an important effect on clinical outcomes. Clinical competency includes technical, non-technical, and cognitive skills such as clinical assessments or decision-making skills (Schwalbe, Timmermann, Gregersen et al., 2024; Möckli, Espinosa, Simon et al., 2023; Kim et al., 2023; Fan & Zhao, 2022; Huter, Krick, Domhoff et al., 2020; Chen et al., 2019; Coster, Watkins & Norman, 2018).

Akpabio and Ella (2015) conducted a quantitative study among nurse specialists, nurse educators, and nurse administrators to explore the nursing informatics preparedness of graduate nurses at a nursing academic institution in Nigeria. The study found that students have a positive awareness of the role of nursing informatics in practice and patient care. It also concluded that nursing students lack sufficient skills in nursing informatics and have a poor understanding of how to transition to nursing informatics. The lack of skills in nursing informatics is confirmed by Chipps, le Roux, Agabus et al. (2022) and Matlhaba, Pienaar and Sehularo (2019), in a study conducted on “*Nursing informatics skills relevance and competence for final year nursing students*” at a local university in the Western Cape. They have concluded that computer literacy skills, informatics literacy skills, and information management skills are relevant to nursing practice despite the changing levels of expertise in these skills among nurses.

Research studies conducted by Najafi and Nasiri (2023), Hallaran et al. (2023), and Oducado and Sumagaysay (2019), indicate that graduate nurses feel less ready with acceptable skill levels to perform in the real world of clinical practice. Schmitt and Lancaster (2019) studied baccalaureate nursing students to assess their readiness to practice as newly qualified Professional Nurses. They found that institutions of training should focus on developing the skills of Gen Z students by integrating technology into their learning environment to enhance their communication skills and to improve self-confidence and readiness to practice. The need to prepare nurses to use IT is confirmed in studies by Ramirez-Avila (2022) and Batholmeus and Pop (2021).

Quantitative studies done by Faloye and Faniran (2023), Ramaila and Molwele (2022), and Gopo (2022) explore the role of the integration of technology in the development of 21st-century skills and competencies in Life Sciences teaching and learning. The findings of the studies are that the integration of technology-mediated learning can foster effective teaching and learning among nursing students. The teachers involved in these studies indicate that technology integration enables the development of skills such as communication, critical thinking, collaboration, and problem-solving. Therefore, technology integration can be perceived to promote the achievement of 21st-century skills and competencies in Life Sciences teaching and learning.

Bangun and Pragholapati (2021) explore how to enhance critical thinking skills in nursing education in preparation for the 4IR. The findings of the study are that critical thinking skills not only guide students to gain ongoing skills but also inspire nursing students to be innovative during their academic training. The use of critical thinking in the use of IT is confirmed in the findings of a quantitative study done by Ho, Chen and Li (2023), on how to develop critical thinking skills among healthcare students. Clarity and reasoning aspects were identified as the main components to enable the development of critical thinking skills through learning sheets, and the supervision of nurse educators to students within the different healthcare settings.

Nursing students who think critically in line with creative thinking and innovation will be useful to continue in the dynamics of the 4IR and beyond in the world of future industries (Walter, 2024; Bangun & Pragholapati, 2021). The fast pace of technological innovations shows no signs of declining and has already noticeably influenced the nursing education curricula (Khraisat, Al-Bashaireh & Alnazly, 2023; Martin, Kaminski-Ozturk, Smiley et al., 2023; Krause & Schnitzler, 2022).

In a study done by Kobekyaa and Naidoo (2023), clinical nurses and clinical educator groups acknowledge that they do not have enough digital health knowledge to meet the demands of the new healthcare era. However, this statement will not apply to most of the future nursing professionals as they are naturally technology literate thanks to their generation being raised with digital technologies (Ebanks, 2024; Loureiro, Sousa & Antunes, 2021).

There is a need to obtain practical skills during simulated training for the future workforce to apply their digital health knowledge and skills in practice (Livesay et al.,

2023; Holland Brown & Bewick, 2023). It is therefore important for HEIs to invest in a digitally enabled nursing workforce, exposing nursing students to digital technologies during their undergraduate nursing training (Manamela, Sumbane, Mutshatshi et al., 2024; Hack-Polay et al., 2023; Harerimana & Mtshali, 2018).

2.5.4 The effect of social and interpersonal relationships in the new healthcare era

The effect of social and interpersonal relationships in the new healthcare era is a very interesting and important topic. Social happiness plays a mediating role in the effect of interpersonal relationships and healthcare service delivery (Bentum-Micah, Cai, Atuahene et al., 2024; Chen, Huang & Lin, 2023). According to Esch, Stefano and Michaelsen (2024) and Jordan (2023), social happiness affects our minds, bodies, and behaviors, leading to longer lifespans, better health, and improved well-being. Social connections are important for our survival. As healthcare technology develops, so do nurses by constantly applying the latest developments to the nursing care of their patients, with increased competence and effectiveness (Tischendorf, Hasseler, Schaal et al., 2024; Mlambo et al., 2021; Kameron & McDermott, 2020). Providing sufficient nursing care in adhering to social happiness psychologically affects nurses, changing their interpersonal relationships (Gamage & Sudusinghe, 2024; Drott, Engström, Jangland et al., 2023).

However, with the recent COVID-19 pandemic and the public health response to it, many characteristics of social relationships such as social networks, support and interaction, and intimacy have been interrupted (Curtis, Wieling, Bryant et al., 2024; Alizadeh, Sharifi, Damanbagh et al., 2023). These types of interruptions can have negative outcomes for individual and public health, such as increased stress, anxiety, depression, isolation, and violence (Brandt, Liu, Heim et al., 2022; Mofatteh, 2020).

Therefore, it is important to consider how to restore and improve social happiness in the post-pandemic era (Gizdic, Baxter, Barrantes-Vidal et al., 2023). According to studies done by Alowais, Alghamdi, Alsuhebany et al. (2023) and Yamin (2019), IT practically affects every sector in the 21st century, including the healthcare sector. IT refers to using different methods, such as telecommunications and computers, to store, retrieve, and send information (Koudouridis, Shalmashi & Moosavi, 2024; Haleem et al., 2021b; Victoria, 2020).

According to Al Najjar and Shafie (2022), Hannawa, Wu, Kolyada et al. (2022), Kwame and Petrucka (2021), and Ahmed (2019), the use of IT in healthcare settings allows nurses with more time to improve patient care, to enhance the quality of healthcare provided, and to allow improved communication between healthcare workers. According to Abo El-Naga, Eid and Mahfouz (2024), and Alderwick, Hutchings, Briggs et al. (2021), IT can also improve the collaboration between medical professionals by reducing medical errors and miscommunication, thereby improving patient care and treatment outcome.

The effect of interpersonal relationships in healthcare

Communication in the healthcare sector is an active process of communication and gathering of information (Alrimali & Alreshidi, 2024; Power, 2023; Kwame & Petrucka, 2021). It is an essential clinical skill that, if performed competently and efficiently, assists with the formation of a relationship of trust between nurses and their patients, and enables a true therapeutic alliance (Shahzeydi, Jazi & Babaei, 2024; Ifrim, Klugarová, Măguriță et al., 2023; Chichirez & Purcărea, 2018). In addition to the nurse's competence and their willingness demonstrated during patient-nurse consultation, kindness, openness, and attention should be offered to patients (Giesen, Timmerman, Bakker-Jacobs et al., 2024; Ferreira, Vieira, Pedro et al., 2023). How nurses respond to their patients' needs and requests is a feature that boosts their performance and adds to an increase in the status of hospitals, and the growing interest of patients in them (Serrano-Guerrero, Bani-Doumi, Chiclana et al., 2024; Mnkandla, Tshitangano & Mudau, 2023).

Communication requires a person who receives the communication to listen actively, understand the message, and answer some questions for analysing non-verbal language. This, in turn, will motivate the speaker to support the conversation (Jäckel, Zerres & Hüffmeier, 2024; Tennant, Long & Toney-Butler, 2023). One possible way to do this is to manipulate the ability of AI to improve patient-doctor relationships (Mao, Hu & Kim, 2024; Siala & Wang, 2022; Bajwa et al., 2021). According to Underdahl, Ditri, and Duthely (2024), and Gandhi, Classen, Sinsky et al. (2023), AI can assist doctors in offering more personalised, effective, and evidence-based care to their patients while lessening their workload and burnout. AI also has the potential to help patients retrieve their health information, monitor their medical conditions, and

communicate with their doctors more easily regarding their medical conditions (Aminizadeh, Heidari, Dehghan et al., 2024; Dave & Patel, 2023). However, according to studies done by Klarin, Ali Abadi and Sharmelly (2024), and Bouhouita-Guermech, Gogognon and Bélisle-Pipon (2023), AI can also pose some ethical and social challenges, such as privacy, accountability, trust, and human dignity. Therefore, it is important to ensure that AI is designed and applied in a manner that respects and improves the human qualities of healthcare (Williamson & Prybutok, 2024; Bouhouita-Guermech et al., 2023).

Patient safety is compromised by medical errors and harmful events associated with miscommunications among healthcare workers (Adu & Zuma, 2024; Afework, Tamene, Tesfaye et al., 2023). It is also affected by human factors such as interpersonal relations (Pappa, Evangelou, Koutelekos et al., 2024; Dietl, Derksen, Keller et al., 2023).

According to Kusumoto, Ross, Wright et al. (2024) and Noviyanti, Ahsan, and Sudartya (2021), communication failures between doctors and nurses are one of the most common causes of harmful events for patients in hospitals. Communication technology such as electronic medical records, email, and Microsoft Teams, which is a feature of health information technology (HIT), may assist in reducing communication failures (Bhardwaj & Kumar, 2024; Sheikh, Anderson, Albala et al., 2021). However, it can also increase other communication failures because of an inadequate understanding of how communication technology is used (Daramola, Adewumi, Jacks et al., 2024; Noviyanti et al., 2021). The increased use of health information and communication technologies is expected to affect communication between nurses and doctors (Wang, Khelfaoui, Ahmed et al., 2024; Nieuwboer, Perry, van der Sande et al., 2018). With the latest developments in communication technologies, healthcare workers are now gradually divided by location and time and are making use of a selection of technologies to conduct their consultations (Tan, Rusli, McKenna et al., 2024; Haimi, 2023).

This transformation in communication among healthcare workers may improve the effectiveness of communication but could also accelerate message doubt, and result in more undesirable happenings (Lee & Yuan, 2024; Aririguzoh, 2022). Communication practices that include the sending of messages only through a single

channel, such as a pager, will differ from the messages sent verbally because content is modified to the form in which it is presented (Wilson, Stuebe, Pearsall et al., 2024; Lafferty, Harrod, Krein et al., 2021).

2.5.5 Knowledge on the use of digital technologies in the 4IR and future industries

Digital technology plays an important role in nursing education, and when combined with a strong curriculum, it allows nursing students to take ownership of their learning (Pfeifer, Fries, Stirner et al., 2024; Gause et al., 2022; Loureiro et al., 2021). A transformation in the teaching and learning environment is needed to improve the knowledge of the use of technology for students in the digital era of the 4IR (Rasdiana, Imron, Rahma et al., 2024; Mondragon-Estrada & Camacho-Zuniga, 2021; Odede, 2021). The knowledge about the use of digital technology will contribute to nursing students who deliver high-quality patient care in the new era of healthcare delivery (Guillari, Sansone, Giordano et al., 2024; Lekalakala-Mokgele, Lowane & Mogale, 2023; Wang et al., 2023).

Various research studies were done on aspects of the readiness of nursing students to use technology in either the education or healthcare sectors. According to Sharma, Al-Haidose, Al-Asmakh et al. (2024), Stoumpos et al. (2023), Altmiller and Pepe (2022), and Moerenhout, Devisch, and Conradie (2018), the fast developments of technology in the healthcare sector are producing a need for transformation of nursing education through the restructuring of curricula.

Three other studies done by Navab, Hoseini and Darvish (2024), Chipps et al. (2022), and Feller (2018), indicate that the use of advanced teaching and learning methods combined with the appropriate combination of nursing informatics in the nursing curricula could allow and prepare computer literate nursing students to deliver high-quality patient care in the dynamic healthcare sector.

Studies conducted by Yan, Echeverria, Fernandez-Nieto et al. (2024), Gause et al. (2022), and Loureiro et al. (2021) indicate that the use of technology is invasive in nursing education. Therefore, all classroom and clinical settings need to improve and expand on using IT in the teaching and learning of learners (Demorest, Cook, Schenk et al., 2024; Staddon, 2020). The importance of the use of IT is also confirmed by studies done by Hernon, McSharry, MacLaren et al. (2023), Ziqubu and Orton (2023), Buabeng-Andoh (2018), and Choi, Lee, and Park (2018). Therefore, nurses must

know and be familiarised with the use of technology that will empower and enable them to provide high-quality nursing and patient care in the new era of healthcare (Dissanayake, Dharmasena & Warnakulasuriya, 2024; Tsarfati & Cojocaru, 2023; Altmiller & Pepe, 2022).

Digital educational technologies (DET) have been slowly introduced and integrated into the learning environment due to the technological rise in the education sector (Sperling, Stenberg, McGrath et al., 2023; Antunes, Sousa & Loureiro, 2021; Zhang & Aslan, 2021). According to Tamilarasi, Kanimozhi, and Jocelyn (2024) and Sim, Rusli, Seah et al. (2022), DET involves virtual scenarios, online programs, and digital resources. DET has insightful changes in teaching practices with positive outcomes in the teaching and learning environment (Tzimas & Demetriadis, 2024; Rusticus, Pashootan & Mah, 2023; Woodcock, Sharma, Subban et al., 2022; Damascena, Santos, Lopes et al., 2019). DET has been integrated into different areas of education to improve teaching and learning and to promote educational academic development (Nordén, 2024; Damascena et al., 2019).

Rettinger, Putz, Aichinger et al. (2024), Hernon et al. (2023), as well as Harerimana and Mtshali (2020), report that students are likely to experience the use of technology as an integrated part of their nursing curriculum for the first time at a tertiary education level. This information is also confirmed in a quantitative study by Raghunathan, McKenna and Peddle (2023) on using technology in the learning environment. Studies indicate that most students report a need for basic computer skills and the application of technology in education, as well as knowledge of hospital system informatics.

According to ElSayary (2024), Bogiannidis, Southcott and Gindidis (2023), and Ryan, Henderson and Aagaard (2021), students should know digital platforms such as ChatGPT and the use of digital devices in clinical settings. ChatGPT offers users instant and clear logical text answers in any form and grouping that is undetectable by current plagiarism software (AlAli & Wardat, 2024; Taecharungroj, 2023; Aswin, Ariati & Kurniawan, 2022). According to Cè, Chiarpenello, Bubba et al. (2024), Gunawan (2023), and Dave, Athaluri and Singh (2023), the healthcare sector depends on its reaction to ChatGPT and its choice of use of it in healthcare settings.

Therefore, it is expected of nurses and other medical staff to familiarise themselves with ChatGPT to assist and teach their patients about treatment choices and nursing

care (Gordon, Daniel, Ajiboye et al., 2024; Miao & Ahn, 2023; Seney, Desroches & Schuler, 2023; Alanzi, 2023). ChatGPT can also assist in focusing on delivering patient care using in-house consultations (Clark & Bailey, 2024; Salvagno, Taccone & Gerli, 2023).

Basheer, Ahmed, Bahroun et al. (2024) and Donough (2022), mention that HEIs will have to evaluate how assessments should be performed to highlight procedures over outcomes. However, academic integrity will be at risk if ChatGPT is used in the curricula and therefore it is required of HEIs to use academic integrity rules and detection software such as Turnitin (Chang et al., 2024; Farrell, Bogodistov & Mössenlechner, 2023; Sullivan, Kelly & McLaughlan, 2023). HEIs should also provide relevant ChatGPT training for all academic staff to reduce the risk of abuse and incorrect use of the software platform (Chang et al., 2024; Perkins, 2023).

The literature points out the involvement of students in technological-directed education, which requires the preparedness of nursing students to work in a nursing environment that involves digital technology.

2.6 EMERGING COMPONENTS FROM THE LITERATURE FOR A POSSIBLE FRAMEWORK

Literature in this study indicated four facets of digital technology that nurses should be ready to participate in a healthcare environment (Figure 2.2).

From the literature, the facets of Digital Health Technologies (DHTs) were found to be; (i) the psychological awareness of using digital devices, (ii) skills development needed for the new healthcare era, (iii) the effect around social and interpersonal relationships, and (iv) need for knowledge on the use of digital devices in the new healthcare era. These four facets formed the conceptual representation of the content of the self-developed instrument as explained in Chapter 3.

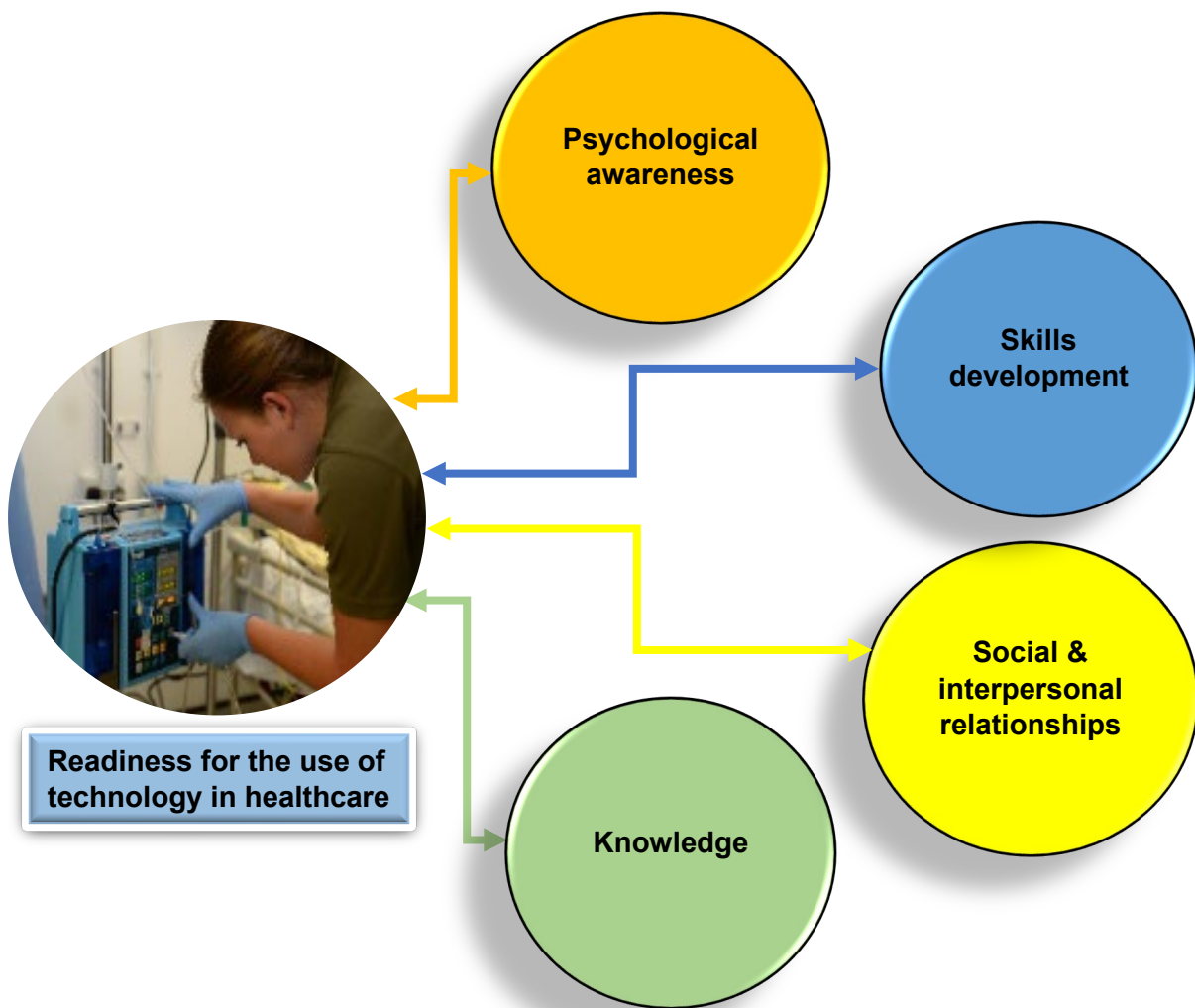


Figure 2.1: Facets on Digital Technology of importance for nursing students

2.7 SUMMARY

Based on the findings of different studies as well as the different methodologies used in them, a quantitative design was found to be appropriate to explore the readiness of senior nurses to use digital technology in the new healthcare era of the 4IR. The quantitative study also highlights how senior nursing students could be supported to participate in the digital changes emerging in the new upcoming healthcare era of the 4IR, and forthcoming industrial revolutions.

Literature indicates the important and much-needed role of nurses to be involved in digital health interventions to efficiently use these technologies, and being able to

provide safe and quality patient care. Literature, however, lacked details and studies on how nurses could be involved with DHTs in their daily tasks. Collaborative efforts amongst nurse managers, policymakers, vendors, and clinical and academic industries can influence digital health capabilities as well as the mindset of nurses towards DHTs in nursing practice.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Methodology refers to how a researcher systematically designs a study to ensure lawful and trustworthy results (Lê & Schmid, 2022; Jansen & Warren, 2020). The researcher adopted special procedures, instruments, and techniques to find, categorise, choose, process, and analyse information about a specific research phenomenon (Thakur, 2021). According to Christofi, Hadjielias, Hughes et al. (2024), Taherdoost (2021), and Sönmez (2018), a research process is an organised manner of applying a scientific method reasonably. The research methodology in this study was determined by the research objectives and formulated within a quantitative design.

3.2 PARADIGM

Research paradigms guide the researcher to understand the scientific findings through their assumptions and principles (Sun & Zuo, 2024; Keong, Md Husin & Kamarudin, 2023; Park et al., 2020). According to William (2024), Means and Mowatt (2023), Luft et al. (2022), and Varpio and MacLeod (2020), understanding a paradigm-specific assumption helps the researcher to explain the research findings and create reliable evidence.

This study focused on the research paradigm of positivism. *Positivism* refers to the name of a social and intellectual organisation that tried to learn from the mistakes of the Enlightenment project that occurred during the Reign of Terror (a period of the French Revolution in 1789) and during the irrationalism (a philosophical movement that emerged in the early 19th century emphasising the non-rational dimension of human life) of the Weimar Republic following Germany's defeat in World War I (Bello, 2024; Morrison, 2022). In research, positivism is defined as a philosophical paradigm that is focused on the ontological (*the object of inquiry that the researcher is set to examine*) belief that reality is measurable and contains only what one can directly observe (Asmawi & Alam, 2024; Guraya, Harkin, Yusoff et al., 2023).

Positivism is linked with the hypothetical-deductive model of science which is a circular process that starts with theory (from the literature in Chapter 2) to formulate hypotheses (Oliveira, 2024; Dong, Ahmad, Irshad et al., 2023; Park et al., 2020).

According to Lama (2024), Park et al. (2020), Bonache and Festing (2020) and Omodan (2022), assumptions of positivism are;

- identifying descriptive connections or causal relationships through quantitative approaches
- identifying fundamental relationships through quantitative approaches, where empirically based findings from large sample sizes are favored
- generalisation as a principle guiding positivist science
- knowing facts that are pure logic and mathematics (numerical)
- having an objective measurement of the behavior of humans
- with the aid of measurements, to produce a statement of cause and effect.

3.3 RESEARCH DESIGN

A research design is a practical plan accepted by a researcher to answer questions lawfully (Cloutier, 2024; Khanday & Khanam, 2023; Barrow et al., 2022). It should be objective and accurate and provide the researcher with insights on conducting research using a specific methodology (Thumvichit, 2024; Khanday & Khanam, 2023; McCombes, 2023a). The design explains a structure that binds the research steps in the study together and lays out the plan for the research study (Mahat, Shrestha & Neupane, 2024). According to Schoormann, Möller, Chandra Kruse et al. (2024) and Renjith et al. (2021), a research design provides an appropriate framework for a study, and to uncover the type of analysis the researcher should carry out to get the desired results.

A non-experimental, descriptive quantitative design was used during this study. It allowed the researcher to distinguish the relationships between variables and to study the existence or occurrence of a phenomenon (Ogbonna, 2024; McCombes, 2023; Shreffler & Huecker, 2023). There is an evident difference between quantitative and qualitative research. In a qualitative study, the researcher uses words rather than numbers, or open-ended questions that are more appropriate for interview questions (Dehalwar & Sharma, 2024; Pilcher & Cortazzi, 2023; Rana, Gutierrez & John, 2021;

Mehrad & Tahriri, 2019). Quantitative research is a formal, objective, and systematic process in which the researcher uses numerical data to obtain the needed information about the phenomenon (Frisby, 2024; Ghanad, 2023). The research process includes a clarification of the research design, the population, the instrument for collecting the data, validity, and reliability, as well as ethical considerations (Makie, 2024; Rodrigues, Morouço, Antunes et al., 2023; Taherdoost, 2021). In this quantitative study, the researcher tested the theory (literature on the phenomenon) and described and compared the relationships between the variables of the phenomenon (Pyo et al., 2023; Bhandari, 2022b; Sibbald, Paciocco, Fournie et al., 2021).

This quantitative design is a systematic and formal process of obtaining information regarding a specific phenomenon within the healthcare sector, such as the readiness to participate in a nursing environment of digital technology. On the other hand, qualitative research is voiced in words to understand ideas, thoughts, or experiences (Adu-Marfo, Kwapong, Oheneba-Sakyi et al., 2024; Streefkerk, 2023).

In this study, the researcher used numerical data to obtain information about the research topic. According to Dehalwar and Sharma (2024), Pyo et al. (2023), and Mohajan (2021), as in this study, the researcher distanced himself from the respondents partaking in the study and focused on the survey, instrument, and relationship between the variables that were examined.

If the researcher had used a qualitative design, it would have had a more interactive approach, and the researcher would have played an active role in obtaining the gathered information (Olmos-Vegaa, Stalmeijerb, Varpioc et al., 2023; Tenny, Brannan & Brannan, 2022; Tomaszewski, Zarestky & Gonzalez, 2020; Majid, 2018). In this study, the researcher was objective and not involved in direct contact with the respondents while they completed the questionnaire. In a qualitative design, also known as an exploratory design, the researcher would have made use of views or experiences that would have been used to code data, discovering patterns in ideas and views (Foster, 2023; Abuhamda, Ismail & Basharat, 2021). A qualitative research study would have used a small sample size (Kaihlanen et al., 2023; Negrin, Slaughter, Dahlke et al., 2022; Bergen & Labonté, 2020). In this study, the accessible population of students formed the total sample.

In this quantitative research study, the researcher tried to decrease any prospect that the study outcomes would be influenced by potential mistakes in the research methodology (Podsakoff, Podsakoff, Williams et al., 2023). The researcher used suitable statistics and followed reliability and validity measures such as pre-testing the questionnaire to reduce reading mistakes (Miao, Han, Wu et al., 2024; Middleton, 2023).

3.3.1 Descriptive survey design

A descriptive survey design is a scientific method that is a formal, objective, and systematic process that requires the use of numerical data to obtain information about the research phenomenon (Bonnamy, Levett-Jones, Carr et al., 2024; Salter, Mutlu & Frowd, 2023; Dangal, 2021). The purpose of a descriptive design in this study was to provide more information on the phenomenon of students' readiness to take part in a healthcare environment of digital technology in hospitals.

The researcher also chose a descriptive survey in this study for the following reasons:

- It was suitable for the research objectives of this study, as the goal was not to gather cause and effect, but to explain the nature of the research topic.
- There was no active intervention on the part of the investigator that could have created researcher bias.
- A survey design was used to study the characteristics of a population to investigate probable solutions to a research problem.
- It was objective because there was no bias in selecting respondents participating in the research. The research data was collected using a structured self-developed questionnaire.

The goal of descriptive research is to describe a population, situation, or phenomenon accurately and systematically (Rahman, 2023; McCombes, 2022). It seeks to describe the status of an identified variable. The researcher set hypotheses before collecting data (Purna Singh, Vadakedath & Kandi, 2023). Systematic collection of information requires careful selection of the units studied and careful measurement of each variable. It can answer what, where, when, and how questions, but not why questions.

In this study, the emphasis was on collecting data via a structured questionnaire (Instrument) that was completed by the respondents (senior 3rd and 4th-year nursing students).

3.4 SETTING

Backåberg, Strandberg, Freeman et al. (2024) and Capili (2021) refer to a research setting as a specific place or location where the research data will be collected. In this study, the researcher did not change or manipulate the research setting.

In the Western Cape, all students at the different nursing training institutions are placed at SANC-accredited healthcare facilities in the Cape's Metropole district. There are currently five higher education institutions offering the new 4-year Bachelor of Nursing programme (Regulation 174 of 8 March 2013) in the Western Cape, and the institution known for "*Smart Technology*", was chosen as the setting where the researcher conducted his study. The nursing programme at this institution is a full-time structured programme with prescribed modules offered to students over four years.

3.5 POPULATION

Ellis and Hart (2023), as well as Nguyen, Resweber and Karhadkar (2023), define a research population as the entire group of respondents or objects that are of interest in a research study, and which meet the criteria of interest for a study by the researcher. A target population in a research study should meet the criteria and requirements that the researcher is interested in conducting (Nyimbili & Nyimbili, 2024; Kohler, Class & Sawert, 2023; LoBiondo-Wood & Haber, 2018). The target population of students in this study (N=108) was registered as learner nurses with SANC (the nursing regulatory body governing nurses in South Africa) at the time the study was conducted.

During the study period, the population was placed for their clinical work-integrated learning (WIL) component at different accredited healthcare facilities in the Western Cape's Metropole district. The WIL component forms 50% of the academic curriculum of this nursing programme.

Accreditation of healthcare facilities by SANC for the training of learner nurses is granted to a facility or institution that complies with the set criteria, requirements, and

standards of Nursing Education and Practice in the Republic of South Africa to protect the citizens of the country. SANC is an autonomous, financially independent statutory body operating under the Nursing Act of 2005 (Act No. 33 of 2005). When the researcher has access to the population, it is called an “accessible population” or the “study population” of a specific study (Keerthana, Indrapriyadharshini, Subraman et al., 2024; Sallam, 2023; Willie, 2022; LoBiondo-Wood & Haber, 2018). The target population (N=108) served as the accessible population for the actual study. The accessible study population was senior nursing students in their 3rd and 4th years who were all studying for a nursing degree at an academic university of nursing in Cape Town.

3.6 SAMPLING

A sample can be defined as a smaller and more controllable depiction of a larger group. It is a separation of a bigger population that includes the characteristics of that population (Thomas et al., 2024; Campbell, Greenwood, Prior et al., 2020). In this study, the accessible population served as the sample. A sample is used in statistical testing when the population size is too big for all members or observations to be included in the test (Giner-Sorolla, Montoya, Reifman et al., 2024; Bhandari, 2022b).

Sampling can be explained as the way of choosing typical components of a research population for a specific research study (De Calheiros Velozo et al., 2024; Fischer, Boone & Neumann, 2023; LoBiondo-Wood & Haber, 2018). In this study, the researcher made use of a probability sampling method for the data collection process. In probability sampling, all the respondents of the accessible population in this study had an equal chance of being selected to participate in the study (Raifman et al., 2022; Polit & Beck, 2018).

A non-probability method would not have provided a level playing ground for selection but rather would have been based on the researcher’s judgment (Liu, Wang & Pan, 2024; Tutz, 2023). In non-probability sampling, the researcher would have used non-random benchmarks such as the availability, geographical location, or skillful knowledge of the respondents as a sampling method to answer a research question (Nikolopoulou, 2022; Renjith et al., 2021).

Table 3.1: Study respondents of the study

Respondents	Accessible population (N)	Sample (n)
3 rd Year	50	50
4 th Year	58	58
Total	108	108

Zickar and Keith (2023), as well as Polit and Beck (2021), refer to a research sample as a group of selected respondents from a study population included in a research study. All the 3rd and 4th-year students who were registered respectively for the four-year Bachelor of Nursing and Baccalaureus of Technology in Nursing programmes, and who were placed in different healthcare settings, were included as the total sample for this study (n=108).

Eligibility (suitability) criteria (Points 3.6.1 and 3.6.2) can be defined as the process where the researcher identifies the study population to decide whether the respondents qualify through a process called inclusion and exclusion criteria (Metcalf, Stephenson, Cairncross et al., 2024; Polit & Beck, 2021).

3.6.1 Inclusion criteria

Mahsoon, Alnakli, Azab et al. (2024) define inclusion criteria of a research study as identifiable characteristics that the study population or group possesses, such as a certain age range or gender. The inclusion criteria for this study were:

- 3rd- and 4th-year nursing students enrolled for a four-year nursing programme at a Higher Education Institution in Cape Town
- Respondents registered as learner nurses with the SANC, the nursing regulatory body governing nurses in South Africa
- Nursing students who, for the duration of their studies, were actively conducting their clinical practical training at accredited healthcare facilities in the Western Cape

3.6.2 Exclusion criteria

Exclusion criteria in a research study were identified as characteristics that viewed a study respondent to be unsuitable for inclusion in a specific study (Molla, Jannadi, Alayoubi et al., 2024; Hiebl, 2023; LoBiondo-Wood & Haber, 2018). In this research study, the exclusion criteria were:

- 1st- and 2nd-year nursing students registered in the four-year Bachelor of Nursing programme. They were junior nurses who were then in the induction phase of the four-year nursing programme. They had minimal exposure to clinical training in healthcare facilities to answer some of the questions related to the research questionnaire.

Liang, Yang and Myers (2024), as well as Tenny, Brannan and Brannan (2022), report that what ultimately matters in a survey is the number of responses you get and not the rate of responses or completion. The number of respondents in the total accessible sample of a study who have completed and returned the instrument will determine the response rate (Khaled, Amro, Bader et al., 2024). A survey response rate can be defined as the estimation of dividing the total number of functional responses collected by the total number of suitable (eligible) respondents in the research sample that was chosen (Eggleston, 2024; Holtom, 2022a). Survey response rates are subjected to many factors that can affect the rate of success. These factors are;

- The type of survey (online, questionnaire, or telephonic survey)
- The clarity of the instructions
- Question type (some questions can be as mentally exhausting as others)
- Survey topic (some niche or sensitive topics may get fewer responses)
- The length of the survey.

According to Lynn, Bianchi and Gaia (2024), and Holtom, Baruch, Aguinis et al. (2022b), a survey response rate below 10.00% is considered very low, while a good survey response rate is anything above 50.00%. In this study, all the respondents took part, resulting in a 100.00% response rate. However, some of the respondents opted not to answer a few of the questions in some of the items.

3.7 METHOD

A research method can be defined as an objective, logical, and systematic method of investigating a phenomenon the researcher plans to develop to allow the accumulation of reliable knowledge (Sarma, Kumari & Bhui, 2024). According to Sá and Serpa (2020), any research study addresses two aspects namely; (i) *the process* and (ii) *the product*. The *process* of research deals with the different methods used to address the problem of research interest (the survey), while *the product* deals with results deriving

from *the process* (the guidelines in Chapter 5). In general, research methods are the foundation for the creation of knowledge in any discipline or domain (Rossi, Rossi, Mukkamala et al., 2024; Osuagwu, 2020).

A survey was used in this study, that was a systematic collection of self-reported data from a larger study population (Senior, Grant, Rhee et al., 2024; Siegel & Jones, 2018). When a researcher is engaging in a survey methodology, the main goal is to obtain valid data that accurately signifies a predetermined population (McCombes, 2022).

The researcher made use of a survey to collect the needed data. A survey was chosen as the method for collecting quantitative information in the form of numerical data to unfold and describe the research phenomenon on digital technology (Poth, Wongvorachan, Bulut et al., 2024; Meyer & Schroeder, 2023; Polit & Beck, 2018).

An interview was seen as unsuitable for this study as it is a qualitative research method that mostly asks questions to collect preferred data (Klingberg, Stalmeijer & Varpio, 2023; Kakilla, 2021). An individual interview usually involves two or more people, one of whom is the interviewer asking the questions, and the other being the participant. The survey in this study wanted to generalise findings to a larger population (Zickar & Keith, 2023; Dunwoodie, Macaulay & Newman, 2022; Polit & Beck, 2018; Vasileiou, Barnett, Thorpe et al., 2018) that would not have been the case in a qualitative study.

The accessible population in this study was two different nursing programmes of nursing students at an academic university of nursing. A survey was found to be the best method for collecting the preferred study data for analysis.

3.7.1 Advantages of a survey

The researcher made use of a survey as it has the following benefits;

A low-cost method of performing research.

A survey is one of the most low-cost methods of collecting quantitative data. Some questionnaires used in quantitative studies can be self-administered making it a possibility to prevent in-person interviews (Rana et al., 2021).

A practical explanation for data collection.

A survey can serve as a practical means of collecting information about specific phenomena. The researcher can target the survey to a demographic of his/her choice

or manage them in different ways. It is up to the researcher to decide what questions get to be asked and in what layout (McCombes, 2022).

A fast way to get the findings that you require.

A survey can provide fast and easy results because of the current mobile and online devices and programs. This method of data collection can create results in as little as one day. The collection of data can sometimes be even less than that depending on the scale and extent of your questions (Nayak & Narayan, 2019).

Surveys provide opportunities for scalability (the capacity to be changed in size or scale)

A well-constructed survey allows the researcher to collect data from a population of any size. The researcher can disseminate his/her research questions to anyone worldwide because of the extent of the Internet (George, 2022).

It allows data to come from multiple sources at once.

When the researcher creates a survey to meet the needs of a demographic, he/she could use multiple data points that are collected from different geographic locations (Baldwin, Pingault, Schoeler et al., 2022).

Surveys allow the researcher an opportunity to evaluate results.

The researcher can measure the information that was collected from surveys and use the data to compare the results from other research attempts (Celhay, Meyer & Mittag, 2024; McCombes, 2022).

3.7.2 Instrument

A self-structured questionnaire with closed-ended questions was developed from the literature. The instrument covered the topic of; *“Readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town”*.

The instructions and questions on the questionnaire were well-edited to remove the uncertain meaning of language in the items. The questionnaire (*Annexure C*) was divided into two sections that took the respondents 30 minutes or less to complete.

Section A consisted of the demographic items that were presented on a nominal scale (e.g., male or female).

Section B addressed the four main facets of technological readiness that were pointed out in the literature around nursing practices that focused on the (i) psychological awareness of using digital devices, (ii) skills development needed for the new healthcare era, (iii) the effect around social and interpersonal relationships and (iv) the need for knowledge on the use of digital devices (Figure 2.2). An ordinal scale (Likert scale) was used as a classification system that allowed the ordering of responses based on a particular attribute.

Table 3.2: Content of the instrument

	Items on the technological readiness of students	Items
Section A	Demographic information	7 items
Section B	Psychological awareness	1 – 7
	Skills development	8 – 18
	Social and interpersonal relationships	19 – 24
	Knowledge	25 – 39

Section B of the questionnaire included open-ended statements graded on a 5-point Likert scale. A Likert scale contains several analytical items that voice a viewpoint on a topic. It is a rating scale that is used to evaluate respondents' opinions, attitudes, or behavior (Broer, van der Walt, Wolhuter et al., 2024). It consists of four (4) or more questions that evaluate a single attitude or characteristic when the response scores are linked (Jamieson, 2024; Tanujaya, Prahmana & Mumu, 2023).

The scale was a summated rating scale that tested the psychological awareness, skills development, social and interpersonal relationships, and knowledge regarding the readiness of senior nursing students to participate in a nursing environment of digital technology in hospitals (Menold, 2023). Likert scales provide a range or series of typically five to seven fixed-choice options. The five-point scale in this study allowed the study respondents to self-report the extent to which they were totally unwilling to totally willing to use the action in the statement on technology (Surbaya, Khan, Surbaya et al., 2024; Shukla, 2023; Dykema, Schaeffer, Garbarski et al., 2022). The study respondents chose the option that best indicated with how they felt about the statement or question (Bhandari & Nikolopoulou, 2023).

According to Suárez-García, Álvarez-Hernández, Arce et al. (2024), Kusmaryono, Wijayanti and Maharani (2022), and Westland (2022), a Likert scale can be prone to a biased response where the respondents tend to e.g., either respond being 'unwilling'

or ‘willing to all the items. This can happen due to fatigue, social influence, and a tendency towards extreme responses (Zhang, Luo & Li, 2023; Westland, 2022). In this study, the 5-point scale had an option of “*neutral*”, forcing the students toward a specific direction. The layout of the scale was as follows:

- 1 = Totally unwilling
- 2 = Unwilling
- 3 = Neutral
- 4 = Willing
- 5 = Totally willing

The ordinal measurement of the questionnaire scale rated the respondents based on their comparative ranking concerning a specific feature (Heo, Kim, Park et al., 2022). The ordinal measurement of the items does not indicate how much greater one level is than the other (Bhandari, 2022b). The study respondents indicated the extent of their ‘willingness’ to use technology as expressed by the item, therefore, the ordinal level of the measurement was applicable (Bhandari, 2022b) (See Table 3.3). The study respondents were required to indicate the most appropriate block by marking it with an (X).

Table 3.3: Example of a Likert-scale statement

<u>Example:</u>	Totally unwilling	Unwilling	Neutral	Willing	Totally Willing
As a nursing student, I am willing	1	2	3	4	5
to use an iPad to do assignments		X			

3.7.3 Data gathering

If the researcher conducted a qualitative study, the collected data would have been interpretation-based, descriptive, and related to language only (Sánchez-Gutiérrez, Minnillo, Fernández Mira et al., 2024; Busetto et al., 2020; Aspers & Corte, 2019). Qualitative data would have helped the researcher to understand why, how, or what is happening behind specific behaviors of respondents’ willingness to participate in the 4IR. The researcher could then have used interviews or observation in the data collection process (Dehalwar & Sharma, 2024; Zahle, 2023; Taherdoost, 2021;

Busetto et al., 2020). However, a qualitative study was inappropriate as the students could not reflect on any experiences as they were new to the 4IR in clinical settings.

3.7.3.1 Preparation of the field

The researcher obtained permission from the Faculty of Health and Wellness Sciences Research and Ethics Committee (*REC Approval Reference No: CPUT/HWS-REC-2022/H4*) at an academic university in the Western Cape Province (see *Annexure D*).

The Head of the Department of Nursing Science in the Faculty of Health and Wellness Sciences of the university was approached, and permission was given to conduct the study at the department (*Annexure C*). After obtaining ethical clearance from the Faculty of Health and Wellness Sciences Research and Ethics Committee, the researcher consulted with the programme coordinators of both year groups who participated in the study. The researcher discussed possible ways of accessing potential study participants and arranged suitable days and times to ensure that his attendance did not interfere with or affect the training programme of the study respondents.

The purpose of the study was explained to the coordinators, along with the voluntary nature of the participation of the students.

3.7.3.2 Pre-testing of the questionnaire

According to Knowles, Grewal, Drever et al. (2024), Bhandari (2022a) and Malmqvist, Hellberg, Möllås et al. (2019), a pilot study allows the researcher to give the questions a 'trial run' evaluating the data collection instrument, and to determine if the study respondents understand all questions. Pre-testing of the instrument was done before the main study, which helped the researcher to evaluate the feasibility of the questions and the correct method of questioning used for the study (Idriss, Mohamad Ikram, Norsarwany et al., 2024).

According to Hardani, Sahbany, Hadi et al. (2024) and Ikart (2019), the researcher can determine any shortcomings in a proposed questionnaire using feedback from pre-testing. Pre-testing of the questionnaire was done using six senior nursing students from the neighboring university and five nursing lecturers in nursing research.

During the pre-testing, the nursing students had to evaluate: (i) the time allocated to complete the questionnaire, (ii) any items misunderstood by the respondents, and (iii)

unclear instructions that guided the study process. The researcher identified and corrected minor editing suggestions made before carrying out the main study that enhanced the reliability of the instrument (Rice, Crouse, Winter et al., 2024; Cheung, Cooper-Thomas, Lau et al., 2023; McCombes, 2022).

The respondents in the pre-testing of this study were excluded from the main study as they were not part of the accessible population (neighboring university) and knew the content of the instrument.

3.7.3.3 Questionnaire distribution

The researcher arranged a convenient time to explain the purpose of the proposed study to the respondents. It was anticipated that the data collection tool would be distributed and disseminated among all the study respondents at the collection site. The researcher arrived at the academic university on the dates and times pre-arranged with the programme coordinators of each year level. This set arrangement was to prevent any interference with the theory or skill laboratory sessions (WIL) of students.

The researcher explained and distributed an information sheet and consent form (Annexures A and B), which were requested to sign the written informed consent form before partaking. The sheet also provided the respondents with all the instructions on how to complete the questionnaire. The researcher also discussed the research process, benefits, and minimal risks (e.g., if a question upsets a student due to a previous incident) associated with the study. The student could then contact the researcher, who had arranged with the counseling services on campus to accommodate a respondent on short notice. The questionnaire was completed during the week when the counseling services ran on campus, and an emergency number was also available. Complete anonymity was guaranteed as the questionnaire was numbered and coded to facilitate data capturing and to audit the collected data. The respondents were made aware that they could withdraw from the study at any time during the study.

The instructions and questions on the questionnaire were written in English and were edited to ensure a clear understanding of the items. All the study respondents understood English well, as it was the official language of communication within the university. It was planned that the study respondents would not take longer than 30 minutes to complete the data collection tool. On completion of the questionnaire, the

study respondents were instructed to place it in an enclosed envelope and deposit it in a sealed box placed in a secure space by the researcher. Students completed the questionnaire in their own time and space during the week.

The data was gathered from April to May 2022, when the researcher did not know the respondents. The total number of nursing students who responded to the study was 108 out of 108 prospective respondents. This amounted to a response rate of 100.00% (Table 3.1).

3.8 DATA ANALYSIS

According to Matos, Freitas, Amado et al. (2024), Rosário and Dias (2023), as well as Taherdoost (2020), data analysis is the systematic organisation and synthesis of research data, followed by the process of translating the collected data into meaningful information. The researcher used different techniques, such as modeling, to reach trends and relationships (Naeem, Ozuem, Howell et al., 2023a). Therefore, the researcher can make assumptions to address the decision-making process used in this process. However, the data needs to be prepared before being used in the data analysis process (Baillie, le Cessie, Schmidt et al., 2022; Niraula, 2019). Numbers are organised into rows and columns to make them workable for the statistician (Taherdoost, 2020).

Qualitative data would have been analysed by gathering the data into groups and themes (Naeem, Ozuem, Howell et al., 2024b; Caulfield, 2022). In this study, the researcher made use of statistical analysis.

The collected data was captured using the Statistical Package for the Social Sciences (SPSS) Version 28 analysis software. The data was then coded electronically, executing mathematical processes. A statistician from a Higher Education Institution was consulted to guide the researcher in analysing the statistics. Research statistics reduce, summarise, organise, manipulate, evaluate, interpret, and communicate quantitative data (Olsen, Klarskov, Dungu et al., 2024; Cooksey, 2020). The absence of quantitative data statistics would have been simply a disordered collection of numbers (Samuels, 2020). Data was analysed by using descriptive and inferential statistics.

3.8.1 Descriptive statistics

Descriptive statistics were used to describe the characteristics of the collected data (Sindermann, Kannen & Montag, 2024; Fulk, 2023; Kaliyadan & Kulkarni, 2019). In this study, descriptive statistics such as the number of responses (n), percentage distributions (%), mean values ($\bar{x}$) and standard deviations (SDs), were used for describing and summarising data meaningfully (Sønning, Krug, Vetter et al., 2024; Hassan, 2023; Cooksey, 2020). These statistics analysed the collection of data in a variety of ways into an organised and visual illustration. The purpose was to facilitate insight into the research phenomenon from different angles (Bhandari, 2022a).

The measuring of central tendencies (the most concise statement of the location of the data, often referred to as an average), i.e., the mean ($\bar{x}$) and standard deviation (SD), were used to describe and summarise data (Parra-Fica, López-Martín & Díaz-Levicoy, 2024). The mean ($\bar{x}$) was the sum of the scores divided by the number of scores being added and is the most used measurement of central tendency for an approximately normal distribution (Hijón-Neira, Pizarro, French et al., 2024; Bhandari, 2023b). A standard deviation (SD) is a statistical measure of precision for a series of recurring measurements (Raffinetti, 2023; Omda & Sergent, 2022). The (SD) expresses the distribution (percentile) of values within a set of observations (Bhandari, 2023b). The lower the value of the (SD), the higher the precision. When the data is more closely focused on a mean value, the respondents obtain similar responses on a statement (Turney, 2023; Omda & Sergent, 2022). An (SD) that is closer to zero (0) indicates that data points are very close to the mean ($\bar{x}$) whereas a larger standard deviation indicates data points are spread further away from the mean value (Thijssen, Tian & Telea, 2024; Bhandari, 2023d).

3.8.2 Inferential statistics

Inferential statistics provided a means for concluding the population based on the data from the sample (Chance, McGaughey, Chung et al., 2024; Abdi, 2023; Amin, 2019). Parametric statistics were calculated as they made assumptions about the underlying population distribution (Pamplona, 2023; Schober & Vetter, 2020). Parametric statistics are based on hypothetical parametric models of data under study (Al-Essa, Etman, Eliwa et al., 2024). This expects that the assumptions or hypotheses made

about the phenomenon in a study, be confirmed by the data, and indicate the reliability of the results found (Tabasi, Rose, Pellegrini et al., 2024; Faizi & Alvi, 2023).

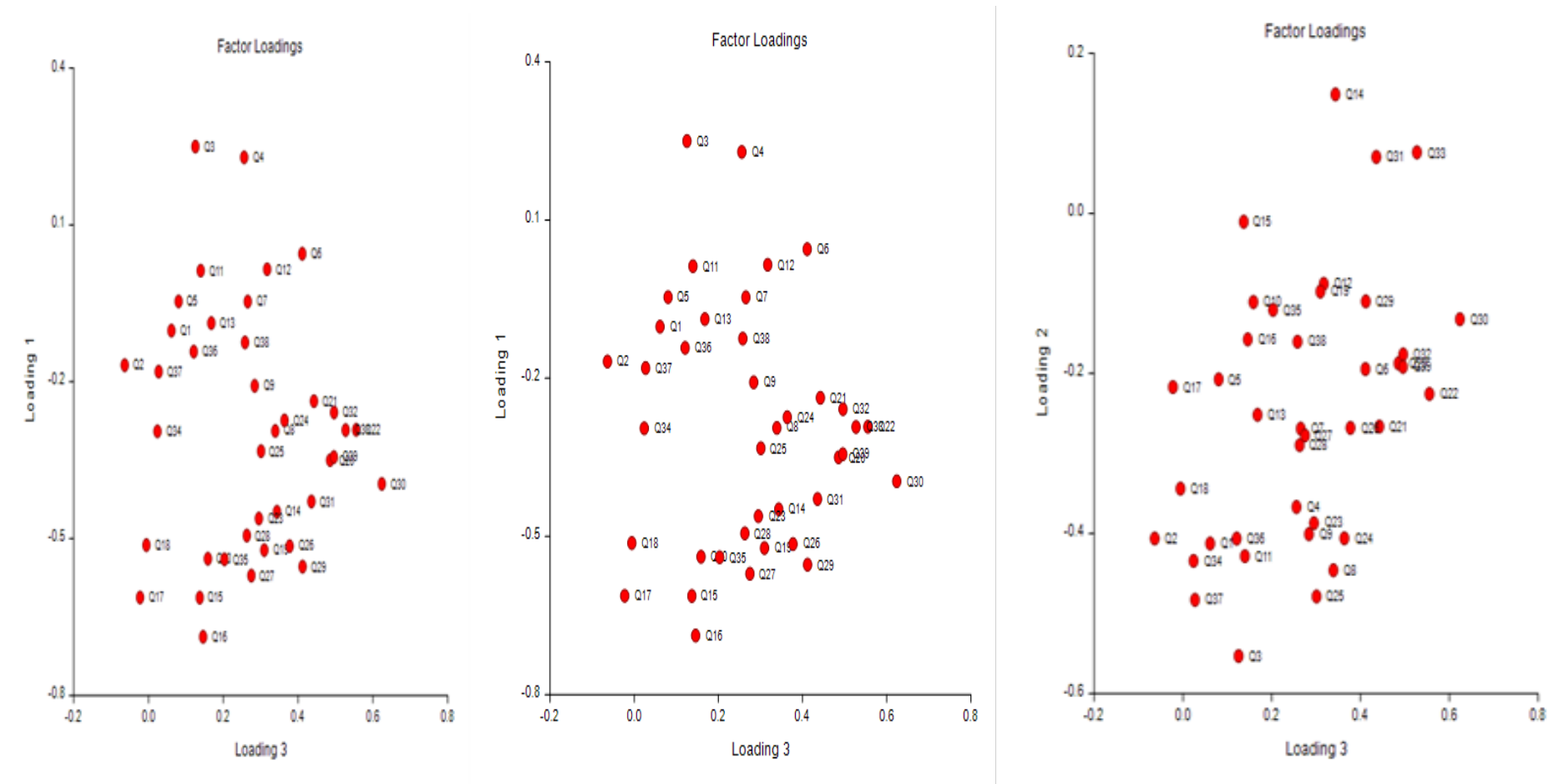
A Pearson's Chi-squared test (χ^2), often referred to as Chi-square tests, are amongst categorical data used to evaluate how likely it is that any observed differences between the sets arose by chance (Cahusac, 2024). Pearson's Chi-square (χ^2) tests are often amongst the most used parametric tests (Rost, 2024).

According to Moghimbeygi and Golalizadeh (2024) and Turney (2023), Pearson's Chi-squared (χ^2) Test is used to measure three types of differences namely; (i) *goodness of fit*, (ii) *homogeneity*, and (iii) *independence*.

- The Chi-Square test of goodness of fit assesses whether an observed frequency distribution differs from a theoretical distribution
- The Chi-Square test of homogeneity relates the distribution of counts for two or more groups using the same categorical variable
- The Chi-Square test of independence measures whether observations consisting of measures on two of the variables stated in a contingency table are independent of each other (Al-Subh, 2024).

The Likelihood Ratio Test refined the findings, whereas the Pearson Chi-Square Test did not find any significant difference between variables and determined the strength of evidence against the hypothesis. Hypothesis testing is a method used for interpreting and drawing conclusions about a population based on the sample data (Shatz, 2024). It helps to decide which sample data will be best in supporting equally selected population claims. Hypotheses predict how the data would present if the null hypothesis were true after data analysis, and to approve or reject the assumption.

Figure 3.1: Principal component analysis on items in the questionnaire



(Muradchanian, Hoekstra, Kiers et al., 2024; Bhandari, 2022a; Casula, Rangarajan & Shields, 2021).

The null hypothesis tested stated:

H₀: There was no relationship between the responses of the 3rd and 4th year nursing students and their readiness (willingness) to participate in a nursing environment of digital technology in hospitals.

The hypothesis was accepted *if the null hypothesis was rejected*:

H₁: The hypothesis stated that there was a relationship between the responses of the 3rd and 4th year nursing students, and their readiness (willingness) to participate in a nursing environment of digital technology in hospitals.

A factor analysis was conducted. According to Ayanwale and Ndlovu (2024), Mohajan (2021), as well as Knekta, Runyon and Eddy (2019), factor analysis is a helpful instrument that a researcher can use for investigating variable relationships. The factor analysis decreases many variables to assess a few interpretable underlying factors (Cuarteros, Ampong, Bagares et al., 2023). An Exploratory Factor Analysis (EFA) was used to reduce the collected data to a smaller set of variables and to explore the underlying theoretical formation of the phenomena. It was used to identify the formation of the relationship between the variables and the respondents (Crusoe, Magnusson & Eklund, 2024; Akbar, Khan, Khan et al., 2023). The factor analysis was initiated with a *principal component analysis* conducted to simplify the structure of a set of variables (Items) in the instrument. The analysis was to reduce the data into a smaller number of components (Figure 3.1).

Rotation was used to simplify the results of the factor analysis (Stevenson, Innes, Gronau et al., 2024; Prokofieva, Zarate, Parker et al., 2023). The goal of the rotation was to achieve an uncomplicated structure that tries to have each variable load on a few factors possible, but to make the most of the number of high loadings on each variable (Prokofieva et al., 2023). A *varimax rotation* was conducted, which is the most common rotation technique in factor analysis that simplifies the factor interpretation (Fu, Fan & Cao, 2024). This rotation further minimised the number of variables with high loadings in three (3) factors (Figure 3.2). Indeed, for each factor, it maximises the variance of its loadings by making high loadings higher and low loadings lower. The minimum number of variables in a factor is three; otherwise, the factor is acknowledged but not interpreted (Tavakol & Wetzel, 2020).

Figure 3.2: The varimax rotation with the eigenvalues of the variables

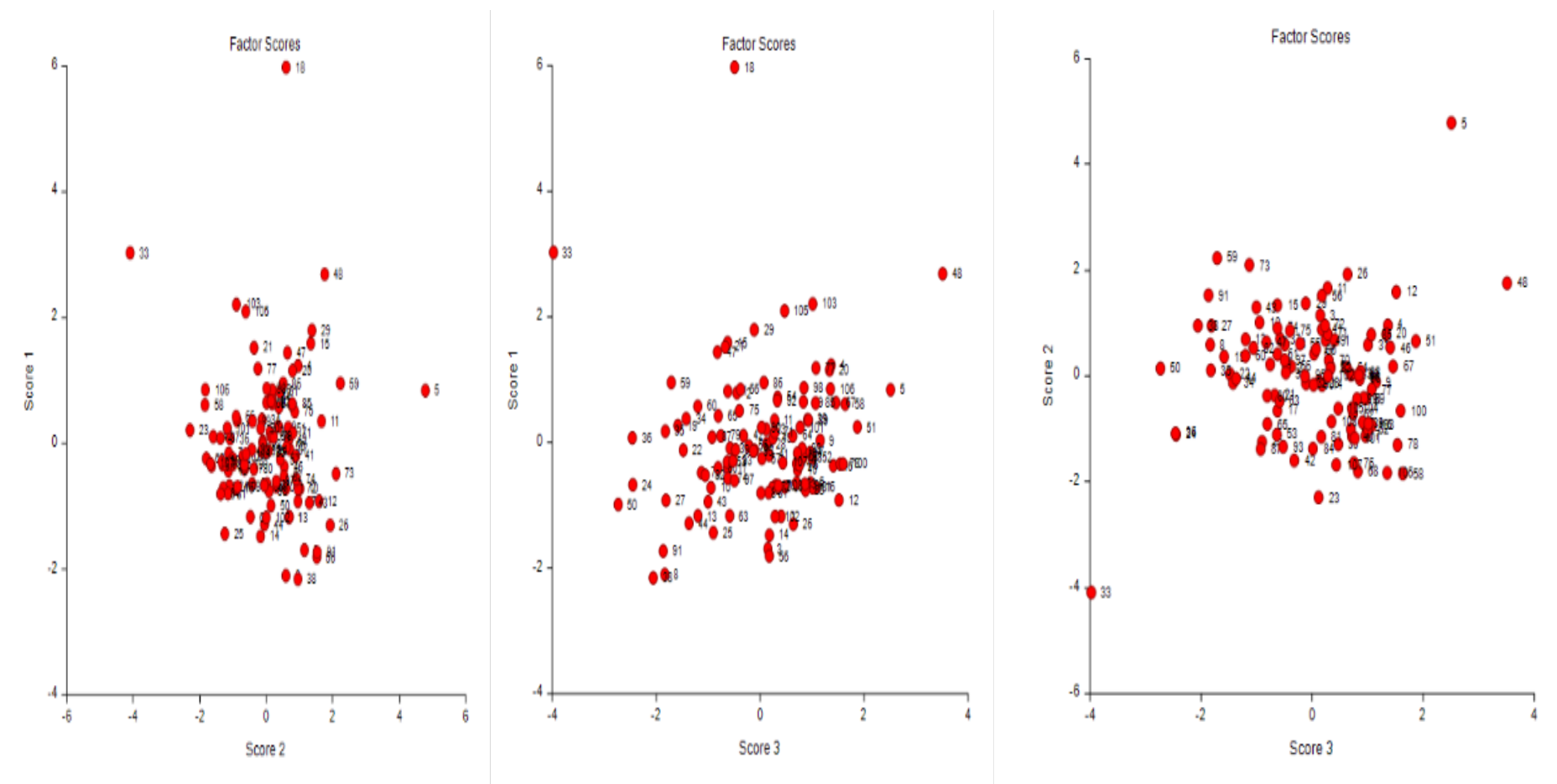


Table 3.4: The three factors and items with factor loadings

Items	Factor 1	Items	Factor 2	Items	Factor 3
	Improvements that the role of IT bring to delivery of effective nursing care		Initiating a changed perspective on using IT devices in delivering nursing care		Staff Insecurity of their future role in a changing nurse-patient environment
10	0.5233	1	0.3729	6	0.2752
14	0.4517	2	0.3729	20	0.5869
15	0.5455	3	0.3989	21	0.5236
16	0.6470	8	0.5102	22	0.5991
17	0.5647	9	0.4730	29	0.5603
18	0.4705	11	0.3434	30	0.7078
19	0.5928	24	0.4845	31	0.5035
23	0.5898	25	0.4731	32	0.5323
26	0.6489	34	0.3934	33	0.4843
27	0.6502	36	0.3706	39	0.5907
28	0.5993	37	0.4549		
29	0.6622				
31	0.5103				
Eigenvalue	7.4565		4.6478		5.3637
Cronbach's Alpha (α)	0.888589		0.766595		0.838651

The rotation method extracted the maximum common variance from all variables and put them into a common score called the eigenvalue (Lee, 2024; Frank, 2023). The factor loading expressed the association of each variable to the underlying factor (Sigudla & Maritz, 2024; Shrestha, 2021). Different opinions around the acceptable factor loadings of items must be included in a factor. For newly developed items, *such as in this study*, the factor loading for every item should exceed 0.5 (Cheung et al., 2023). Another opinion is that a factor loading of more than 0.30 usually indicates a moderate correlation between the item and the factor (Aslan & Onal, 2024; Gebremedhin, Gebrewahd & Stafford, 2022). The minimum number of variables in a factor is three, otherwise, the factor is acknowledged but not interpreted (Tavakol & Wetzel, 2020).

Perez (2024) and Chatterjee and Dsilva (2021) suggest that when the items have different frequency distributions, use the stringent cut-offs going from 0.32 (poor), 0.45 (fair), 0.55 (good), 0.63 (very good), or 0.71 (excellent). Mansoor and Mahabadi (2023) suggest that the value of an item with a loading of below 0.2 should be removed, as was done in this study. The items in Table 3.4 mostly had a value of 0.5, and items

higher than 0.2 were included for the study. Factor 1 had the highest eigenvalue of 7.4565 (Table 3.4). Factor 1 obtained the highest Cronbach's Alpha (reliability and internal validity) of 0.888589. Items 4, 5, 7, 12, 13, and 35 were excluded from the varimax rotation; however, they were addressed in the findings.

3.9 VALIDITY AND RELIABILITY

According to Panda and Mohapatra (2024), Farkas, Krajcsi, Janacsek et al. (2023), and Coleman (2022), validity and reliability are essential elements of a well-structured research study. These elements indicate how well a method, technique, or test measures a phenomenon.

3.9.1 Reliability

Reliability refers to the consistency and dependability of the instrument used by a researcher to measure the variables represented in the tool (William, 2024; Taherdoost, 2021; Polit & Beck, 2018). It indicates that an instrument is repeatable and consistent if used on a different day and time for the same respondents, the results should be the same (Wilkie, Jordan, Foulkes et al., 2023; Dalawi, Isa, Chen et al., 2023; Middleton, 2023; Mackey & Gass, 2021). Wilkie et al. (2023) mention that reliability refers to the extent to which the instrument can replicate the same results if used by more than one researcher.

The reliability of this study was determined by using the Cronbach's Alpha coefficient (α). The reliability of any measurement refers to the extent to which it is a consistent measure of a concept, and Cronbach's Alpha (α) test is one way of measuring the strength of that consistency (Raykov, Marcoulides, Anthony et al., 2024; Streefkerk, 2022). Cronbach's Alpha measures the level of agreement of responses on a standardised 0 to 1 scale. Higher values in a Cronbach's Alpha (α) test indicate a higher agreement between items (Gong, Bolseguí, Lee et al., 2024; Bujang, Omar & Baharum, 2018).

An alpha score of more than or equal to 0.7 indicates an acceptable value, while an alpha value of 0.8 or higher indicates a good value (Avinç & Doğan, 2024). The normal range of values is between -1.00 and +1.00, with higher values reflecting better internal consistency.

Table 3.5: Cronbach's alpha (α) of the three (3) factors

Factors	Cronbach's alpha (α)
Factor 1	0.888589
Factor 2	0.766595
Factor 3	0.838651

Coefficients of .80 or higher are considered *especially desirable* (Bell, Chalmers & Flora, 2024; Taber, 2018). Factors 1 and 3 obtained a Cronbach's Alpha (α) of higher than .80, and Factor 2 could also be seen as reliable. The factors indicated the reliability of the instrument and ranged between 0.766595 and 0.888589.

The reliability indicated the degree of accuracy with which the instrument measured the phenomenon, and that was to determine the readiness (willingness) of senior students to participate in a nursing environment in hospitals in Cape Town. The same instrument was given to all the respondents who participated in the study. Reliable instruments enhance the study and help in identifying important differences or relationships that happen in the study population (Taherdoost, 2021; Ferreira, Andrade & Almeida, 2020). The instrument obtained *an overall high Cronbach's Alpha (α) of 0.831* in this study.

3.9.2 Validity

Validity refers to the accuracy and truthfulness of the scientific findings of a quantitative research study (Rosenzweig, 2022; Mohajan, 2021; Polit & Beck, 2021). Validity is a process that is harder to assess than reliability. It is assessed by checking how well the results correspond to ascertain theories and other measures of the concept (Cheung et al., 2023; Mackey & Gass, 2021). It is about the control of the research design and the instrument that will be used to gather the information (Heroes, Devoogdt, Damstra et al., 2024; Fields, Carbery, Schulz et al., 2023).

There are different types of validity namely face validity, content validity, construct validity, and criterion validity (Dalawi et al., 2023; Mackey & Gass, 2021).

Face validity means that an instrument appears to measure what is intended to be measured as determined by the researcher and the experts who have been consulted (Masuwai, Zulkifli & Hamzah, 2024; Visalli, Béno, Nicolle et al., 2023; Andrade, 2018). The data collection tool was distributed to six (6) senior students (peers) at a

neighboring university also offering the 4-year nursing programme, and 5 (five) nurse educators at the research site to complete. The purpose was to determine if the students understood the instructions and questions in the tool, and if any changes were to be made. The results of the pre-testing of the instrument by these respondents confirmed that all items in the questionnaire were relevant, and minor editorial corrections were required. The instrument appeared to measure what it was intended to measure, as it covered all the main aspects.

Content validity refers to the degree to which an instrument comprehensively includes the range of meanings (content) that are essential to describe the concept, and that all the different elements of the variables in question are measured (Jordan, Watowicz, King et al., 2024; Folger, Bostic & Krupa, 2023; Middleton, 2022). Content validity in this study was ensured by asking five nurse educators who were experts in the field of General Nursing Science, to evaluate if the content of the instrument measured the topic that was investigated and found to be content valid. These staff members were asked to assess whether the questionnaire contained any unclear, leading, or duplicate questions, or questions that could influence the responses of the respondents. Face and content validity were therefore determined.

Construct validity was confirmed through the factor analysis that assisted in the identification of theoretical concepts, as well as approving the correctness of a theoretically developed construct (Alavi, Biros & Cleary, 2024; Dabbagh, Seens, Fraser et al., 2023). A factor analysis was done, and three (3) factors were rotated that indicated high Cronbach's Alphas (α) (Table 3.5), and therefore internal validity was determined.

Internal validity could be threatened by the degree to which the independent variable could affect the dependent variable (Ahuja & Lio, 2024; Drew, 2023; Streefkerk, 2022). The identified threats to internal validity include but are not limited to testing, instrumentation, and selection bias (Barker, Habibi, Aromataris et al., 2024; Hassan, 2023; Flannelly, Flannelly & Jankowski, 2018).

Measures undertaken during the data analysis and interpretation phases ensured internal validity and included:

- the pre-testing of the instrument

- the use of an appropriate method of data analysis that was a statistical package of social sciences (SPSS) Version 28
- adherence to ethical standards during the data collection e.g., allowing the respondents to withdraw from the study at any stage
- the maintenance of accuracy during data analysis and factor analysis with the use of a statistical program and the support of interpretation with true and relevant data.

The research design was non-experimental. No variables were manipulated to ensure that sound methodology was followed. Objectivity was ensured by using the same structured self-administered questionnaire during data collection (Tawash, Cowman & Anwar, 2024; Leon, Lapkin, Fields et al., 2022).

Measures were undertaken during the selection of the population and sample to ensure internal validity, and a representative sample included the total sampling of respondents.

External validity refers to the degree to which findings can be generalised from the sample to the population of the sample (Bläsius & Fischbeck, 2024; Eckel, 2023; Middleton, 2022). In this study, external validity was ensured by a total sampling method to justify the generalisation of the findings to the accessible population (Hassan, 2023).

Potential threats to external validity were monitored by the researcher, such as the reactions of the respondents to the questions being asked, and the researcher could control the setting (e.g., handing out the questionnaires) and not influence the responses given by students (Abulela & Khalaf, 2024; Chen, Kilobits, Devine et al., 2022). These threats were avoided by using a self-administered questionnaire that the respondents could complete in their own time without the presence of the researcher. The study respondents were instructed to close the completed questionnaire in an envelope and deposit it in a sealed box that was placed at a specific spot arranged with the department.

3.10 ETHICAL CONSIDERATIONS

Research ethics is handling all research respondents in a study with the required respect throughout the research study (Ombaka & Muturi, 2024). The researcher needed to adhere to ethical practices regarding the handling and storing of their research data. The concept also refers to the trustworthiness of the study, and the truth of the findings as reported.

According to Lövestam, Bremer-Hoffmann, Jonkers et al. (2024) and Taquette and Borges da Matta Souza (2022), ethical standards are meant to protect all parties, respondents, researchers, and their institutions, and the reputation of research itself. Research ethics regulate the standards of conduct for scientific researchers (Miteu, 2024).

It is important to adhere to ethical principles to protect the dignity, rights, and well-being of research respondents (Shrestha, 2024). According to Kooli (2023) as well as Barrow et al. (2022), ethical behavior and ethical considerations are very detailed. Therefore, the researcher should be careful when doing research in the field of human activities. Ethical considerations when doing research are affected by decreasing any harm to the study respondents while in turn, improving any possible benefit in research (Pelletier, Kaewkitipong & Guitton, 2024; Burgess et al., 2023; Taquette & Borges da Matta Souza, 2022; Macdonald et al., 2020).

Ethical clearance to conduct the study was obtained from the Faculty of Health and Wellness Sciences, Research and Ethics Committee (HREC), Ethics reference number: (*CPUT/HWS-REC-2022/H4*). The study was conducted at the Cape Peninsula University of Technology (CPUT), the Faculty of Health and Wellness, and the Department of Nursing Science at the Bellville campus.

3.10.1 The right to privacy, confidentiality, and anonymity

Anonymity was ensured by making it impossible to link specific data to either an institution or person (William, Mirembe & Nabaasa, 2024; Varkey, 2021). The study respondents were assured of confidentiality as their details would not be published (Sim & Waterfield, 2019; Bhandari, 2022b). No information was collected or shared

apart from the researcher, supervisors, or statistician. No names of the respondents or institutions would be mentioned in publications.

According to Herington, Li and Pisani (2024) and Streefkerk (2023), any personal information that could identify individuals had to be excluded from the study. In this study, the researcher gave each questionnaire an identifying number for monitoring and coding purposes. After the completion of the questionnaire, the respondents placed and closed the instrument in an envelope provided by the researcher and deposited the envelopes into an enclosed box on a private spot in the department, after which they were collected by the researcher.

The researcher's report was also written in such a way that none of the respondents or groups could be identified by their responses (Ng, Santoro, Cobey et al., 2020).

Students completed the questionnaires in their own time and place, ensuring the protection of their privacy during the completion process.

3.10.2 The right to justice and equality

The researcher treated all the respondents fairly and used total sampling that ensured a fair selection of study respondents. Total sampling gave everyone in the accessible population an equal chance of participating in the research (Kim, 2024; Raifman et al., 2022; McCombes, 2022). The contact details of the researcher were provided on an information sheet if questions on the instrument, or his support during the study, were needed. The findings of the study were shared with them after the report was examined through a presentation, and the results will be published in open-access journals.

3.10.3 The right to protection and truthfulness

According to Taquette and Borges da Matta Souza (2022), Bhandari (2022a), and Viertiö, Kiviruusu, Piirtola et al. (2021), no actions that could be harmful or cause any discomfort to the respondents, must occur. All information regarding this study was explained to the respondents in a detailed information sheet with the informed consent form, and the respondents could contact the researcher at any time if any questions surfaced (Barrow et al., 2022; Drolet et al., 2022; Bhandari, 2022a; Xu, Baysari, Stocker et al., 2020). All the data collected will be kept under lock and key for five

years after the research report has been written, after which it will be destroyed by deleting all files on the content of the computers. The researcher made use of cloud-based storage options such as Google Drive or Microsoft OneDrive with a protected password to store the digital research data. The Protection of Personal Information Act 4 of 2013 (POPIA), which came into effect on 1 July 2021, requires that research data comprising personal information must be protected in a secure storage environment (Abdulrauf, Adaji & Ojibara, 2024; South African Government Gazette, 2013). The instrument or data obtained will not be used in another research study without obtaining ethical clearance.

3.10.4 The right to freedom of choice and withdrawal

In this study, research respondents were asked to participate voluntarily and were advised of their right to withdraw from the study at any point should they feel uncomfortable with participating (see Annexure A). According to Wijohn, Newcombe, Reynolds et al. (2024), Bhandari (2022a) and McCombes (2022), the respondents who decided not to participate, must not be forced or harassed in any way.

The concept of informed consent serves to enhance the ethical norms of voluntary participation (Stirling & Takarangi, 2024; Manti & Licari, 2018; Barrow et al., 2022; Grant, 2021; Bos, 2020). Voluntary participation in a research project implies that the respondents fully understood the possible risks involved. The researcher informed the respondents about who he was and what his affiliation and qualifications were.

The researcher respected the human dignity of the respondents and obtained voluntary, written, and informed consent from each respondent that was attached to the questionnaire. Written informed consent was obtained from all the respondents before the questionnaires were completed.

3.11 SUMMARY

The researcher used the correct research paradigm of positivism with a non-experimental, descriptive quantitative design to explore and describe the readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town. A survey was the method of choice in this study and was a convenient method to reach the accessible population. Pre-testing of the instrument was done to

determine the face and content validity, as well as the feasibility of the questionnaire. The construct validity of the instrument was obtained by a factor analysis in which three factors rotated with high-factor loadings. The field preparation was conducted, and the necessary ethical clearance and permissions were obtained from the relevant committee and institution.

The accessible population (N =108) served as the sample (n = 108) in the study. Probability sampling was conducted, which meant generalisation could be made to the accessible population. Arrangements to access the study population and for data-gathering were correctly undertaken through the Head of the Nursing department while considering ethical principles of privacy. A self-developed questionnaire from the literature was the correct instrument to collect the needed data. The questionnaire contained a reasonable number of questions that could be completed in around 30 minutes or less. The respondents received an information sheet and consent form beforehand, which were discussed with them and returned anonymously after completion. An expert statistician conducted the data analysis. The instrument obtained *an overall high Cronbach's Alpha (α) of 0.831*. The instrument measured what it was supposed to measure. Descriptive data analysis was followed in this study. The principles of validity and reliability were taken into consideration during the research process, while the researcher was also adhering to ethical principles. The findings of the research were used to achieve the goal of the study.

CHAPTER 4

FINDINGS OF THE STUDY

4.1 INTRODUCTION

In answering the research questions on the topic of interest, the researcher analysed the data in an organised and comprehensible manner (Fife & Gossner, 2024; Dawadi, Shrestha & Giri, 2021; Johnson, Adkins & Chauvin, 2020). In this chapter, the results of the descriptive and inferential analysis were presented that addressed the first objective of the study, which was formulated as: *To determine the extent to which senior students were ready to participate in a nursing environment of digital technology in hospitals in Cape Town.*

4.1.1 Background to the survey

A self-developed structured questionnaire with closed-ended questions was developed from literature studied on the topic of “*Readiness of senior nursing students to participate in a health environment of digital technology in hospitals in Cape Town*”. The self-administered questionnaire was shared among 3rd and 4th-year nursing students (n=108) who worked in hospitals within the Metropole of Cape Town. A statistical analysis contained descriptive and inferential data.

Researchers should expect a 60.00% response rate as the goal of return of questionnaires in survey research (Elliott, Brown, Hambarsoomian et al., 2024; Holtom, 2022a; Sataloff & Vontela, 2021). It stated that theoretically, the response rate could be anywhere from 0.00% to 100.00%, although it is almost unheard of to get a 100.00% response rate. The response rate in this study was 100.00%, however, a few of the study respondents did not answer all the questions. Obtaining a 100.00% response rate in surveys is ideal because it guarantees that the respondents' perceptions are reliable and data-rich (Wu, Zhao & Fils-Aime, 2022).

The number of responses varied on the questions.

The questionnaire was divided into two (2) sections.

Section A: Demographics

Section B: Technological readiness, according to the sequence of the headings in The questionnaire.

4.2 FINDINGS ON SECTION A: DEMOGRAPHIC INFORMATION OF THE RESPONDENTS (ITEMS 1-7)

Section A consisted of the demographic items presented in tables and figures.

4.2.1 Gender of the respondents (Item 1)

From the total of study respondents (n=108, 100.00%), just over two-thirds (n=73, 67.60%) were females, and over a quarter (n=33, 30.55%) were males. Only two (n=2, 1.85%) of the respondents identified themselves as neither male nor female (Figure 4.1).

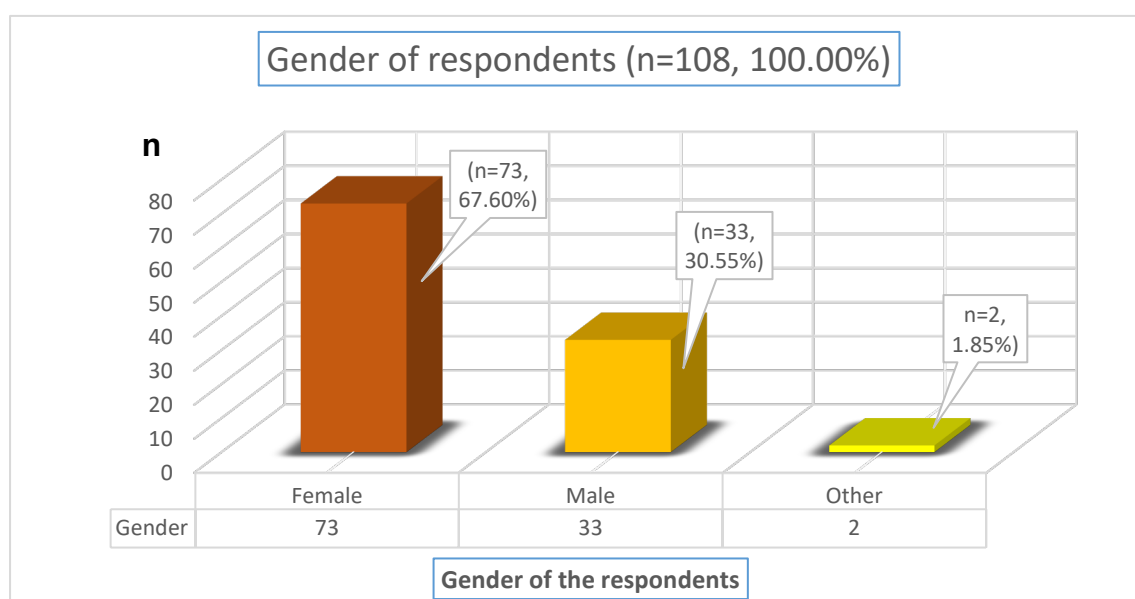


Figure 4.1: Distribution of respondents from different genders

According to Ramjan, Maneze, Salamonson et al. (2024), nursing is still regarded as a universal profession that is dominated by females; therefore, a high number of female respondents in this study. However, the number of male nurses has over the last decade, continued to grow at all levels in the categories of nurses. Nursing is still a long way from overcoming the stigma of classifying the nursing profession as a female-dominated job that is only done by females (Smith, Horne & Wei, 2024).

4.2.2 Age of the respondents (Item 2)

Figure 4.2 illustrates the generational age distribution of the study respondents (n=108, 100.00%). Their ages ranged between 20 and 52 years and represented the Generation X, Y, and Z cohorts. More than three-quarters (n=98, 90.74%) of the total respondents were younger than 32 years of age and could be categorised as young adults from the Millennials (Generation Y), who were born between 1981 and 1996 (Howarth, 2023). The minority of the respondents (n=10, 9.26%) were 33 years and older, and formed part of the Generation X cohort born between 1975 and 1980 (Fisher, 2024; Howarth, 2023).

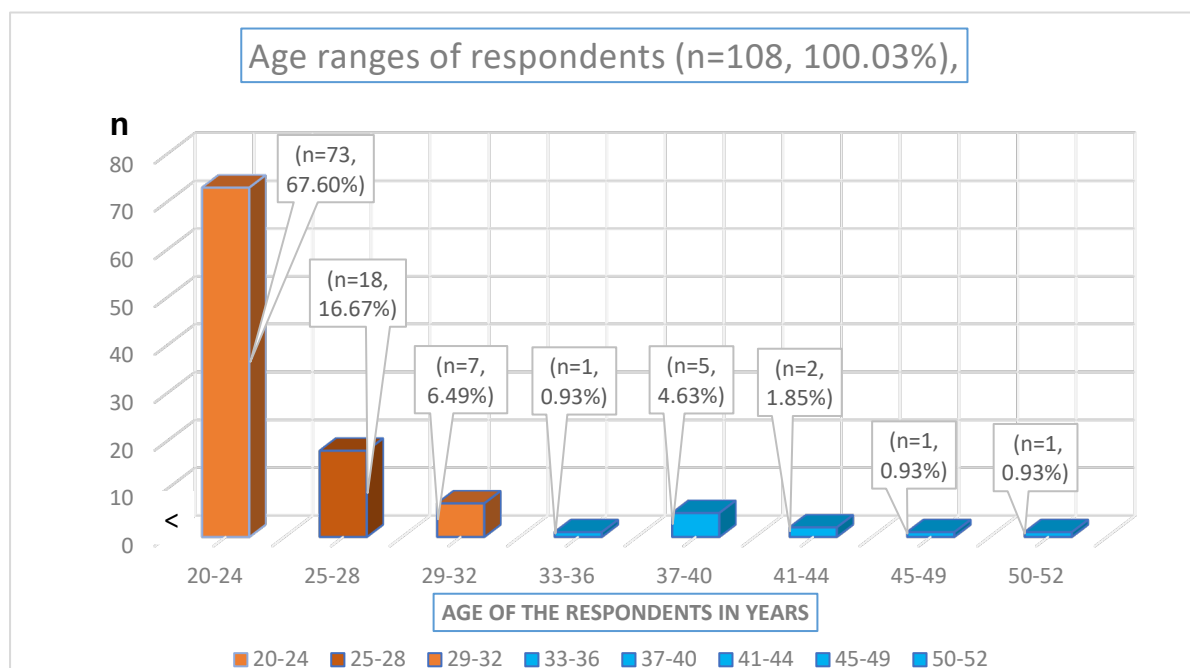


Figure 4.2: Distribution of respondents from different generational age groups

The youngest respondents in the group were aged 20 (n=8, 7.41%), while the eldest respondent was 52 years of age (n=1, 0.93%) (Table 4.2).

4.2.3 Home language of the respondents (Item 3)

Figure 4.3 illustrates that less than two-thirds (n=65, 60.18%) of the respondents spoke Xhosa as their first language of preference, while the second largest group of respondents (n=13, 12.04%) used Afrikaans as their home language.

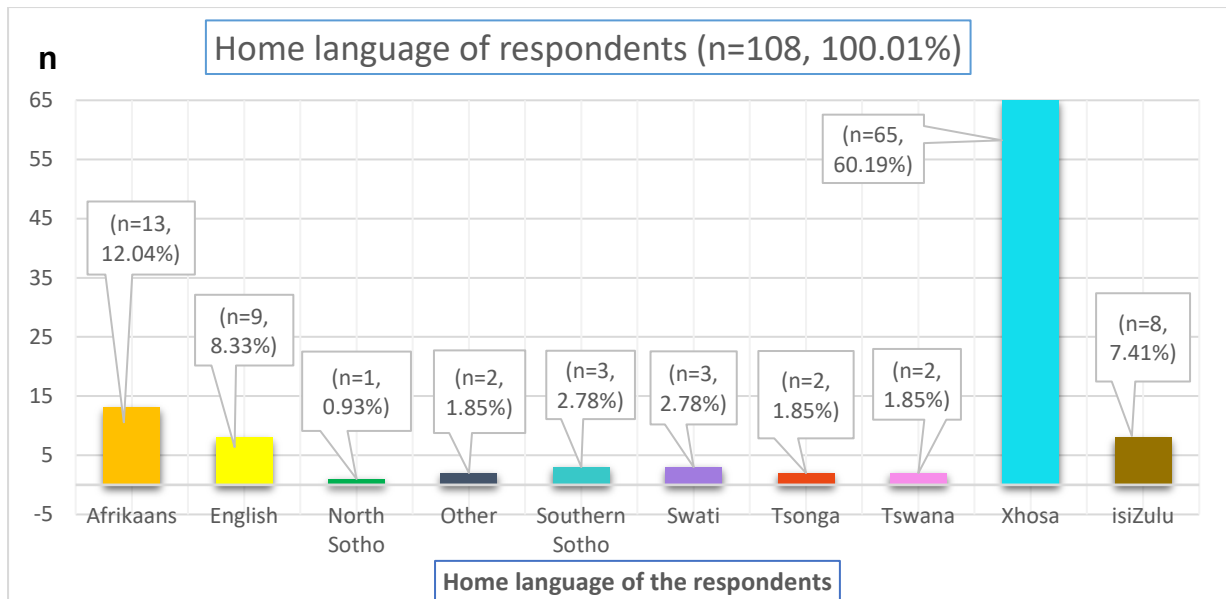


Figure 4.3: Home language distribution of the respondents

The minority of languages spoken by 11 (10.18%) respondents was;

- North Sotho (n=1, 0.93%)
- Southern Sotho (n=3, 2.78%)
- Swati (n=3, 2.78%)
- Tsonga (n=2, 1.85%)
- Other (n=2, 1.85%)

The languages that were predominantly spoken by most of the respondents were isiXhosa (n=65, 60.19%), followed by Afrikaans (n=13, 12.04%) and isiZulu (n=8, 7.41%).

4.2.4 Year level of study (Item 4)

Figure 4.4 illustrates the year level of study for all the respondents who participated in the study. Just less than half of the respondents (n=50, 46.30%) were 3rd year nursing students, versus half of them (n=58, 53.70%), who were 4th year nursing students.

Although there was a difference in the year level and programme name of the respondents, both groups were registered at SANC as learner nurses in a 4-year nursing programme that would allow them to receive the qualification as a Professional Nurse and Midwife.

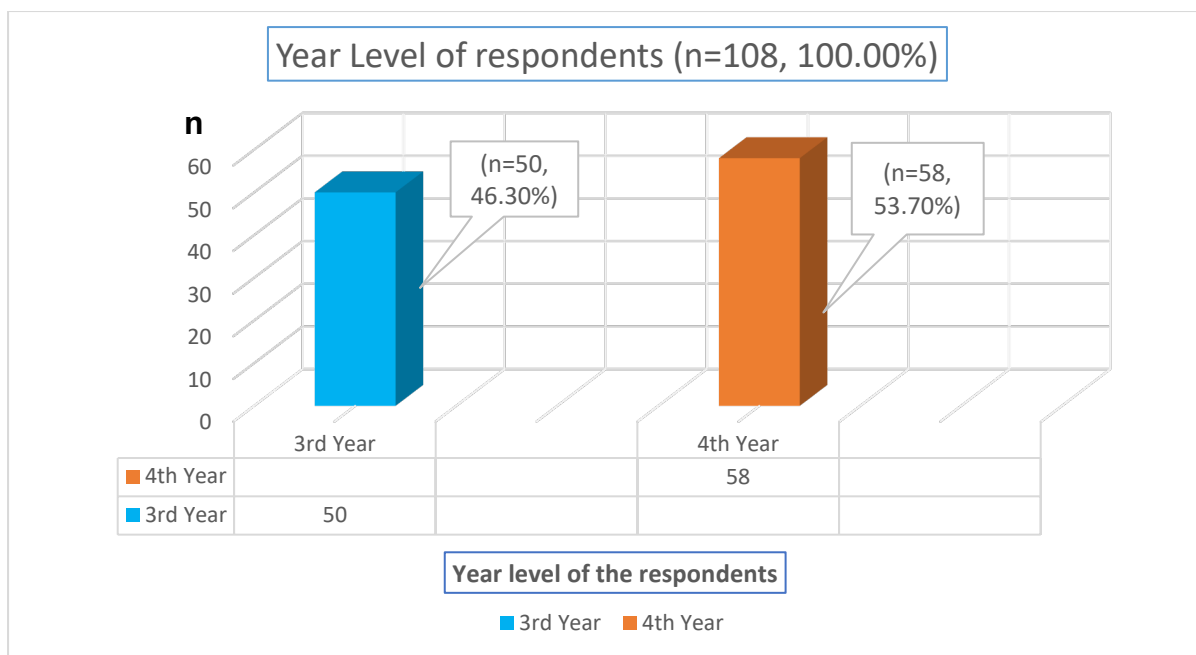


Figure 4.4: Distribution of respondents in the different nursing programmes

During the study, the 4th-year respondents who were enrolled in the R.425 Baccalaureus of Technology in Nursing – R.425 training programme (n=58, 53.70% of the total of 108 respondents) as seniors, were completing their WIL hours at different accredited healthcare facilities in the Western Cape. The accredited facilities are affiliated with the nursing training institution and accredited by SANC for students to complete their training. On the other hand, the 3rd-year respondents registered for the R.174 Bachelor of Nursing programme (n=50, 46.30% of 108 respondents) were attending theoretical classes at the academic institution.

4.2.5 Names of the current year programmes (Item 5)

Figure 4.5 illustrates the names of the current nursing programmes of the respondents who participated in the study. Less than half of the 108 respondents recruited in the study (n=50, 46.30%) were enrolled in the R.174 Bachelor of Nursing programme. In contrast, over half (n=58, 53.70%) of respondents were enrolled in the R.425 Baccalaureus of Technology in Nursing programme.

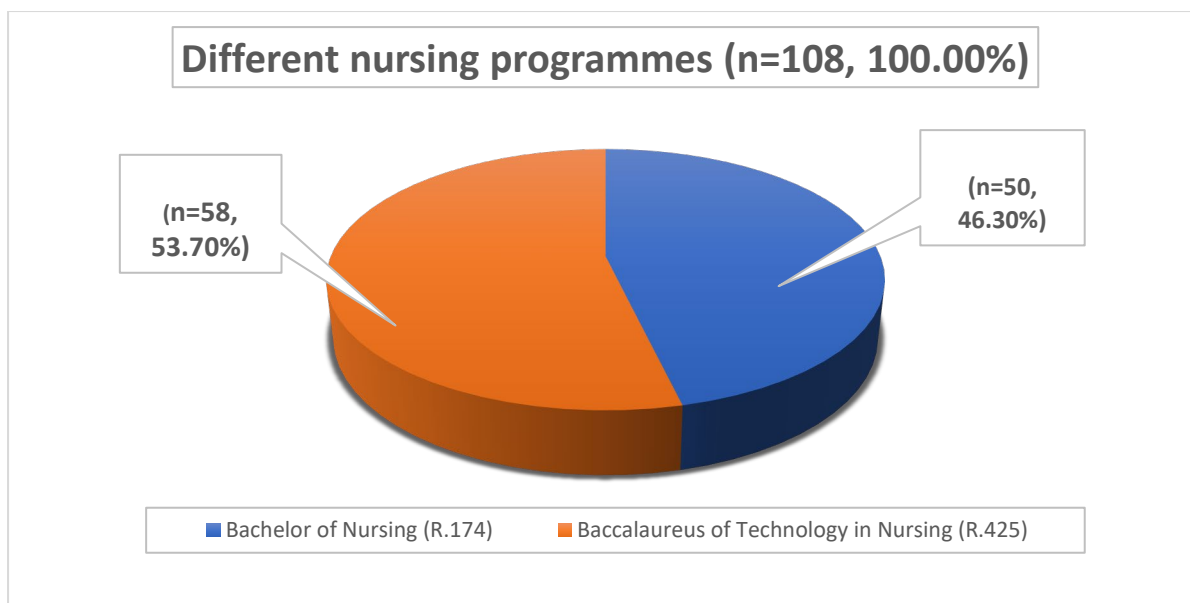


Figure 4.5: Distribution of respondents in the different nursing programmes

The Baccalaureus of Technology in Nursing is a legacy training programme under Regulation 425 of 22 February 1985 as amended and is being phased out like all other legacy qualifications in the country in line with the current requirements of the Higher Education Qualifications Sub-Framework. According to SANC (2023), the Bachelor of Nursing – Regulation 174 of 8 March 2013, leads to a qualification in General Nursing and Midwifery, whereas on the other hand, the students registered in the Baccalaureus of Technology nursing programme, will obtain a qualification in General Nursing, Community Nursing Science, Psychiatric Nursing Science and Midwifery on completion of their studies.

4.2.6 Marital status (Item 6)

Eight (n=8, 7.41%) of the total respondents (n=108, 100.00%) were married, versus more than three-quarters (n=99, 91.67%) of single respondents. Only one (n=1, 0.93%) of the respondents indicated that he/she was in a relationship, but not yet married (Figure 4.6).

Early marriage hurts the well-being of the youth towards higher education with major health and social influence worldwide (Siddiqi, Greene, Stoppel et al., 2024). Educational motivation, career goals, and early marriage are linked with some personal and related factors (Mahdinia, Pourabrahim, Sedaghat et al., 2024; Pourtaheri, Sany, Aghaee et al., 2023).

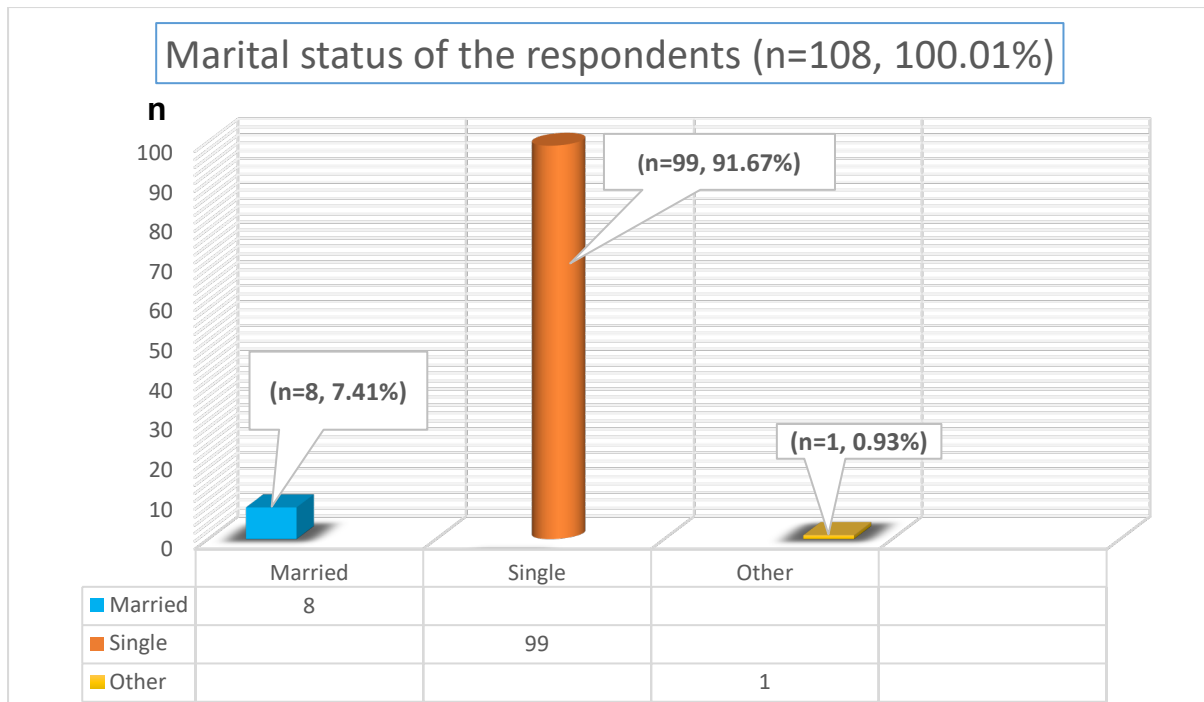


Figure 4.6: Distribution of respondents regarding marital status

Knowledge and financial stability are among the important goals for pursuing higher education, while the main problems during marriage include poor study routines, lack of money, and motivation (Urio & Nziku, 2024; Moore, Nguyen, Rivas et al., 2021). Love, pregnancy, and the break from parental control are some of the main reasons for early marriage. On the other hand, adolescent perceptions linked with getting married are related to their gender, age, level of parental education, number of siblings, education level, and financial income (Ndou, 2024; Hyseni Duraku, Jemini-Gashi & Toçi, 2020).

4.2.7 Daily computer usage (Item 7)

Almost two-thirds (n=65, 60.19%) of the respondents indicated that they were using computers daily, while more than a third (n=43, 39.81%) of the respondents indicated that they were not using computers daily (Figure 4.7).

More than a third (n=43, 39.81%) of 108 (100.00%) respondents indicated that they had no daily access to the usage of a computer but were frequent computer users at the academic training institution due to insufficient data for internet access at home. More than half (n=65, 60.19%) of the students indicated that they had daily access to the use of a computer.

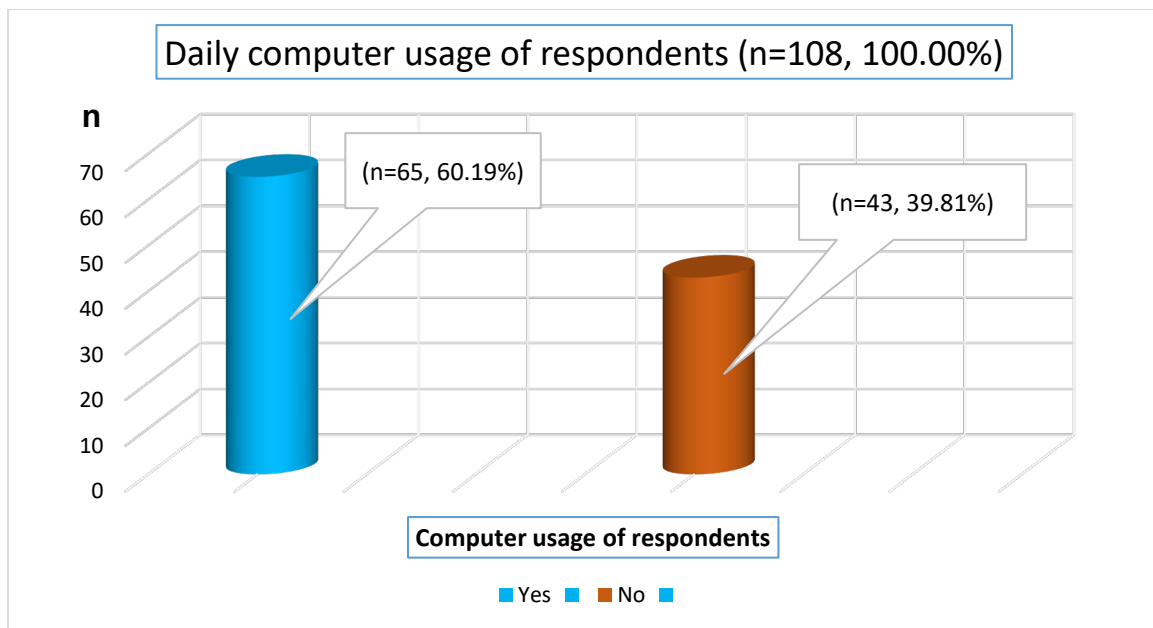


Figure 4.7: Distribution of respondents on daily computer usage

Studies by Pérez-Juárez, González-Ortega and Aguiar-Pérez (2023) and Gajdics and Jagodics (2022), indicate that students often use digital devices such as smartphones or tablets for social media, playing games, text messaging, and emailing rather than for class work. The successful rollout of digital technology in the nursing curricula can develop the knowledge and computer skills of nursing students to help them attain high-quality nursing and patient care in the new era of healthcare (Altmiller & Pepe, 2022; Nes, Steindal, Larsen et al., 2021). Findings of studies conducted by Siregar (2024), Mohammadnejad et al. (2023), and Simões, Oliveira and Nunes (2022), confirm that the inadequate usage of computers or digital devices by students, disadvantages them about their knowledge and computer literacy, and have a negative effect on how they will provide high-quality nursing care in the forthcoming industries of healthcare.

4.3 FINDINGS ON SECTION B: TECHNOLOGICAL READINESS OF THE RESPONDENTS (ITEMS 1-39)

4.3.1 Presentation of Section B

Section B of the questionnaire had 39 items that were divided into four (4) sections.

- Section B1: Psychological awareness (Items 1-7)
- Section B2: Skills development (Items 8-18)
- Section B3: Social and interpersonal relationships (Items 19-24)
- Section B4: Knowledge (Items 25-39)

An exploratory factor analysis was performed which rotated the items into three (3) important factors that incorporated the four (4) sections (dimensions of skills development, social and interpersonal relationships, knowledge, and psychological awareness) that the instrument measured (Table 4.1).

Table 4.1: Three factors with dimensions and items

Factors	Dimensions in the questionnaire corresponding with the factor	Items rotated in the subsections
Factor 1 Improvements that the role of IT brings to the delivery of effective nursing care	▪ Skills development	10,14,15,16,17,18
	▪ Social and interpersonal relationships	19,23
	▪ Knowledge	26,27,28,29,35
Factor 2 A new approach to using IT devices requires changed perspectives in delivering nursing care	▪ Psychological awareness	1,2,3,8,9,11
	▪ Skills development	24
	▪ Knowledge	25,34,36,37
Factor 3 Staff Insecurity of their future role in a changing nurse-patient environment	▪ Psychological awareness	6
	▪ Social and interpersonal relationships	20,21,22
	▪ Knowledge	30,31,32,33,39

The factor analysis (Table 3.4) formed the framework of the discussion on the items in Chapter 4. The findings presented each of the three factors and items in the following format:

1. A description of the factor analysis according to the dimensions in the questionnaire.
2. Descriptive and inferential statistics of 108 (100.00%) respondents that include the number of responses (n) on an item, mean values ($\bar{x}$) and standard deviations (SD), significant differences between responses of two groups (age, marriage status, year levels), to interpret the responses of the respondents.

The number of responses on items varied.

Descriptive statistics describe and summarise the data by providing an overview of the important characteristics of the sample (Fulk, 2023; Cooksey, 2020). A 5-point Likert scale was used to measure the items on the willingness of senior students to participate in a healthcare environment using digital technology in hospitals in Cape Town.

For purposes of this study, it was assumed that the concept of '*willingness*' used in the Likert scale in the questionnaire indicated the '*readiness*' of students, as in the title of this study. Literature confirms that '*readiness*' is a synonym for '*willingness*' and refers to being prepared to handle a situation or task, having the necessary competencies and mindset to take it on (Wani, Jan, Tyagi et al., 2024).

The responses on the questionnaire rating scale were measured as '*willingness*', and the conclusions drawn in the items referred to the corresponding concept of '*readiness*' of students.

Table 4.2: Likert rating scale

5-Point Likert scale	Willingness	Readiness
1	Totally unwilling	Totally not ready
2	Unwilling	Not ready
3	Neutral	Neutral
4	Willing	Ready
5	Totally willing	Totally ready

The findings of the study were presented according to the three (3) factors in the following format:

- (i) A description of the factor analysis that represented the dimensions regarding the facets of technology in the questionnaire.
- (ii) Descriptive statistics of the items in each of the factors. For purposes of this study, the items were presented according to:
 - the mean values that were obtained for the factors.
 - the mean values of the items in each of the factors.
 - the responses of the students that indicated a rating of:
 - <15.00% on being “neutral” on an item.
 - >10.00% on being “unwilling” on an item.
 - <30.00% on being “willing” on an item.
 - <60.00% on being “total willing” on an item.
- (iii) A mean value ($\bar{x}$) of:
 - 3.50 indicated a low mean value.
 - 3.51 - 4.19 indicated normal mean values.
 - 4.20 indicated a high mean value.
- (iv) A standard deviation (σ) of:
 - < less than 0.80 indicated a narrow distribution of responses around the mean value.
 - 0.81- 1.20 was a normal distribution around the mean value.
 - 1.21 and above, was a wide distribution around the mean value.

For purposes of this study, the term “*readiness*” referred to the “*willingness*” of students to use digital technology in healthcare facilities in Cape Town.

4.3.2 Factor 1: Improvements that the role of IT brings to the delivery of effective nursing care

4.3.2.1 Factor description

Factor 1 indicated the improvements that the role of IT brought to the delivery of effective nursing care and addressed the role in (i) *skills development*, (ii) *social and interpersonal relationships*, and (iii) *knowledge of students* (Table 4.3). The overall Cronbach's Alpha (α) of Factor 1 was 0.888589. Digital technologies are gradually affecting the nursing profession worldwide (Chen & Liou, 2024; Isidori, Diamanti, Gios et al., 2022). According to a study by Kaihlanen et al. (2023), the change to a digitally supported profession will increase the benefits of high-quality patient care. Therefore, IT and skill development regarding the use of technology in healthcare are a must for nursing students during their training (Jobst, Lindwedel, Marx et al., 2022).

Table 4.3: Factor 1 - Improvements that the role of IT brings to the delivery of effective nursing care

Dimensions in Factor 1	Items	Cronbach's Alpha (α) per item
Promoting skill development	10	0.8830
	14	0.8859
	15	0.8824
	16	0.8783
	17	0.8811
	18	0.8850
Social and interpersonal relationships between students and patients	19	0.8799
	23	0.8806
Knowledge of the students	26	0.8770
	27	0.8770
	28	0.8798
	29	0.8768
	31	0.8840
	35	0.8831

(i) ***Skill development of students***

According to Chua, Rajasegeran, Gunasegaran et al. (2024) and Jobst et al. (2022), the skill development of nursing students is important during their training. The use of mobile application technology, such as a smartphone, can provide nurses with quick retrieval of patient and nursing care information, e.g., a reminder to administer pain medication to a patient (*Item 10*). Nurses can obtain basic computer Windows

programs such as Microsoft Word, Excel, or PowerPoint in preparing a patient presentation to their colleagues (*Item 14*) (Zaman, Goldberg, Kelly et al., 2021; Nes et al., 2021).

These computer programs (*Item 15*) can also be used as electronic health records for patients to improve patient care through accurate records (Motsi, 2024). On the other hand, access to internet sources can offer more information such as safeguarding to administer certain medicines to a patient while working in a healthcare unit (*Item 16*). Mobile devices used for social reasons such as tweets, are now being used for quick access to health information needed to monitor a patient's health and vital signs (Masoumian Hosseini, Masoumian Hosseini, Qayumi et al., 2023).

Accurate recordkeeping is also important after checking vital signs and is reviewed to e.g., to accommodate more digital-orientated devices (*Item 17*). Cellphones can also be used to search for information about a patient's diagnosis, e.g., search for suitable treatment options (*Item 18*). The cloud can be used in many ways to obtain vital healthcare information regarding patients (Golightly, Chang, Xu et al., 2022; Mehrtak, SeyedAlinaghi, MohsseniPour et al., 2021).

(ii) Social and interpersonal relationships between students and patients

According to a study by Al Shamsi, Almutairi, Al Mashrafi et al. (2020), patients who are not fluent in English and are from non-English speaking communities may not receive the fair and rightful nursing care that they are entitled to. If nurses are not fluent in speaking the first language of their patients, they may depend on the use of a professional interpreter or another staff member who may be fluent in the required language (Espinoza & Derrington, 2021; Panayiotou, Gardner, Williams et al., 2019). With the worldwide increase of mobile technologies, healthcare workers are slowly using digital translation tools to fill this gap between the patient's diagnosis and giving consent to interpreters (Habib, Nair, Von Pressentin et al., 2023; Thonon, Perrot, Yergolkar et al., 2021). The quality of the relationship between healthcare providers and patients of different cultures improves through digital translation applications such as Google Translate (*Item 19*) as confirmed by Khurana, Koli, Khatter et al. (2022) and Hwang, Williams, Zucchi et al. (2022).

Maroju, Choudhari, Shaikh et al. (2023) found that the rise of telemedicine has a widespread effect on how healthcare is delivered. Telemedicine has also been found to be a successful method to improve patient safety and waiting periods for treatment, and allows patients to consult with their doctors over long distances (*Item 23*). It allows easy and professional access to healthcare for patients worldwide and has helped to reduce costs and improve the quality of healthcare (Anawade, Sharma & Gahane, 2024; Haleem et al., 2021b).

(iii) Knowledge of the students

Students should have knowledge about digital technology (Martín-Lucas & García del Dujo, 2023). Digital devices play an important role in education and when combined with strong teaching methods, allow nursing students to take ownership of their learning (Wang et al., 2023; Loureiro et al., 2021).

Nursing education institutions in South Africa are gradually integrating IT into their nursing curricula to prepare nursing students to meet the demands of the new era of healthcare (Pereira da Veiga et al., 2024; Matahela & Makhanya, 2024; Donough, 2023). Digital developments allow new methods and opportunities for improving the work outcomes of nurses (Saleh, Saleh, Elsabahy et al., 2023). Mobile technologies will also increase the number of patient admissions, leading to earlier diagnosis and treatment (*Item 26*).

Findings by Zenani, Sehularo, Gause et al. (2023), and Singh and Masango (2020), indicate that with the integration of IT into nursing education programmes, nursing students will benefit from competently using technology as Professional Nurses (*Item 27*). Haddad, Annamaraju and Toney-Butler (2023) report that the use of IT in healthcare institutions reduces the paperwork that is currently done by nurses (*Item 28*). IT will also offer quality nursing care using smart-bed technology as an in-room monitoring tool that can provide regular updates on a patient's activities such as vital signs (*Item 29*).

Huai, Li, Wang et al. (2024) as well as Azher, Cervantes, Marchionni et al. (2023), state that many healthcare training institutions are making use of virtual reality technology such as simulation to improve the learning experience of nurses (*Item 35*).

4.3.2.2 Factor 1: Findings on the role that IT brings to the delivery of effective nursing care statistics

Factor 1 described the improvements that the role of IT brings to the delivery of effective nursing care and addressed the dimensions of (i) skill development, (ii) social and interpersonal relationships, and (iii) knowledge.

An overall view of the distribution of the mean values of the three dimensions in Factor 1 is outlined in Figure 4.8. The items on which respondents indicated a more negative response towards their readiness to use technology were in the dimension of social and interpersonal relationships (Items 19, 23). Item 19 had the lowest, however, still a normal mean value in Factor 1 ($\bar{x}$ 4.10, SD 1.03), although 40 (37.04%) of the respondents were *totally unwilling to neutral* regarding the use of digital translation applications that could improve the quality of the relationship between healthcare providers and patients.

Similarly, in Item 23 (Figure 4.8), respondents were *totally unwilling to neutral* towards using telehealth/telemedicine that could allow patients to consult with doctors over long distances ($\bar{x}$ 3.87, SD 1.11).

The items in Factor 1 on the improvements that the role of IT brings to the delivery of efficient nursing care received responses to a higher readiness in the skill development and knowledge dimensions, than in the social and interpersonal relationships. The dimension of *skill development* indicated the highest mean values ($\bar{x}$ 4.20 - 4.56), with a narrow distribution of responses (SD 0.71 - 0.87) around the mean values. This indicated that students were more similar in their responses, thus similarly ready to use technology on items mentioned in the skill development section. The responses of students on the *knowledge dimension* also indicated high mean values ($\bar{x}$ 3.93 - 4.47) with a narrow to normal distribution of responses around the mean values (SD 0.81 - 1.01).

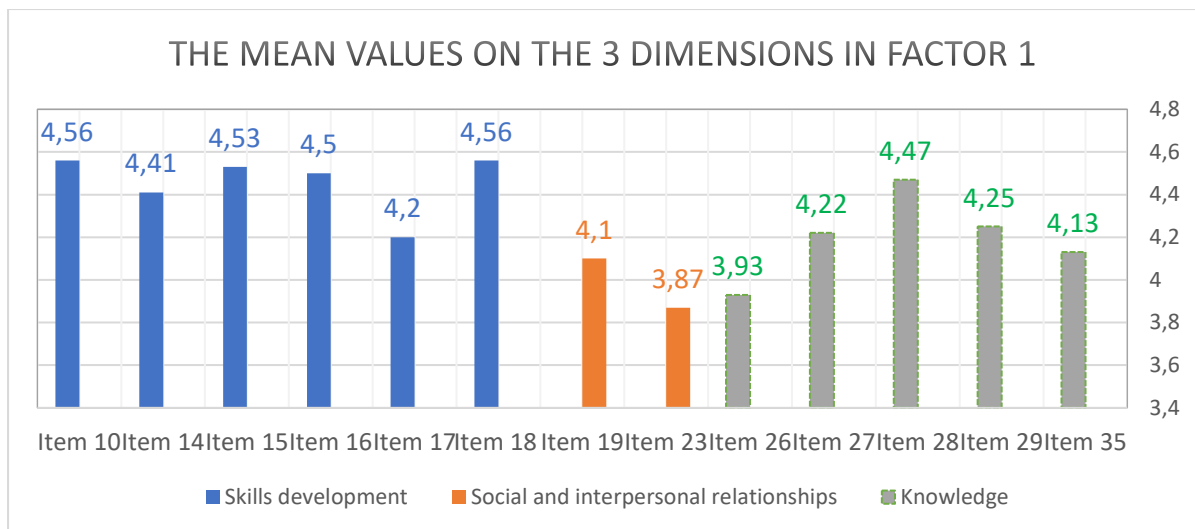


Figure 4.8: The mean values ($\bar{x}$) of items on improvements that the role of IT brings to the delivery of efficient nursing care (Factor 1)

Table 4.4: Descriptive statistics Factor 1: Improvements that the role of IT brings to the delivery of effective nursing care (n=108)

Items	As a nursing student, I am willing (ready) to participate in the digital changes emerging in healthcare, because...	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		(x̄)	SD		
		1		2		3		4		5							
		n	%	n	%	n	%	n	%	n	%	n	%				
		Skills Development															
10	The use of mobile application technology e.g., a smartphone will give nurses speedy access to information, e.g., a reminder to give pain medication to a patient.	1	0.93	1	0.93	9	8.33	22	20.37	75	69.44	108	100.00	4.56	0.76		
14	Nurses can access basic computer Windows programs such as Microsoft Word, Excel, or PowerPoint in preparing a patient presentation to peers.	2	1.85	2	1.85	8	7.41	33	30.56	63	58.33	108	100.00	4.41	0.85		
15	Nurses make use of electronic health records for patients as it improves patient care through accurate records.	1	0.93	1	0.93	5	4.63	33	30.55	68	62.97	108	*100.02	4.53	0.71		
16	Nurses can access internet sources to gain more information, e.g., the precautions of giving certain medicines to a patient, while working in a healthcare unit.	1	0.93	1	0.93	8	7.41	31	28.70	67	62.03	108	100.00	4.50	0.75		
17	Routine nursing tasks such as the checking of vital signs are revised to e.g., accommodate more digital-orientated devices.	2	1.85	1	0.93	17	15.74	41	37.96	47	43.52	108	100.00	4.20	0.87		
18	Nurses can use their cell phones to search for information about a patient's diagnosis, e.g., explore appropriate treatment options.	2	1.89	1	0.94	4	3.77	27	25.48	72	67.92	106	100.00	4.56	0.77		
		Social and interpersonal relationships															
19	The quality of the relationship between healthcare providers and patients of different cultures improves through digital translation applications such as e.g., Google Translate.	2	1.89	6	5.66	22	20.75	26	24.52	50	47.16	106	99.98	4.10	1.03		
23	Telehealth/telemedicine allows patients to consult with doctors over long distances.	3	2.78	10	9.26	26	24.07	27	25.00	42	38.89	108	100.00	3.87	1.11		
		Knowledge															
26	Mobile technologies increase the number of patient admissions, leading to earlier diagnosis and treatment.	4	3.77	3	2.83	26	24.52	37	34.90	36	33.97	106	99.99	3.93	1.01		
27	The introduction of the subject of Technology in nursing education programmes will benefit nurses to use technology as Professional Nurse.	2	1.85	3	2.78	17	15.74	33	30.56	53	49.07	108	100.00	4.22	0.94		
28	The use of Information Technology (IT) reduces paperwork done by nurses.	1	0.93	1	0.93	13	12.04	24	22.22	69	63.89	108	*100.01	4.47	0.81		
29	The use of smart-bed technology as an in-room monitoring tool provides regular updates on a patient's activities such as vital signs.	2	1.85	2	1.85	12	11.11	42	38.89	50	46.30	108	100.00	4.25	0.86		
35	Healthcare training institutions make use of virtual reality technology such as simulation to enhance the learning experience of nurses.	2	1.85	5	4.63	15	13.99	40	37.04	46	42.59	108	*100.10	4.13	0.95		

Due to statistical calculations do not add to 100.00%

Factor 1: Skills development on improvements that the role of IT brings to the delivery of effective nursing care (Items 10, 14, 15, 16, 17, 18)

The descriptive statistics regarding the dimension of skills development in Factor 1 indicated that the highest mean values were obtained on Items 10 ($\bar{x}$ 4.56, SD 0.76) on the use of mobile application technology such as smartphones that would give nurses speedy access to patient information, and Item 18 ($\bar{x}$ 4.56, SD 0.77) on nurses who could use their cell phones to search for information about a patient's diagnosis (Figure 4.8).

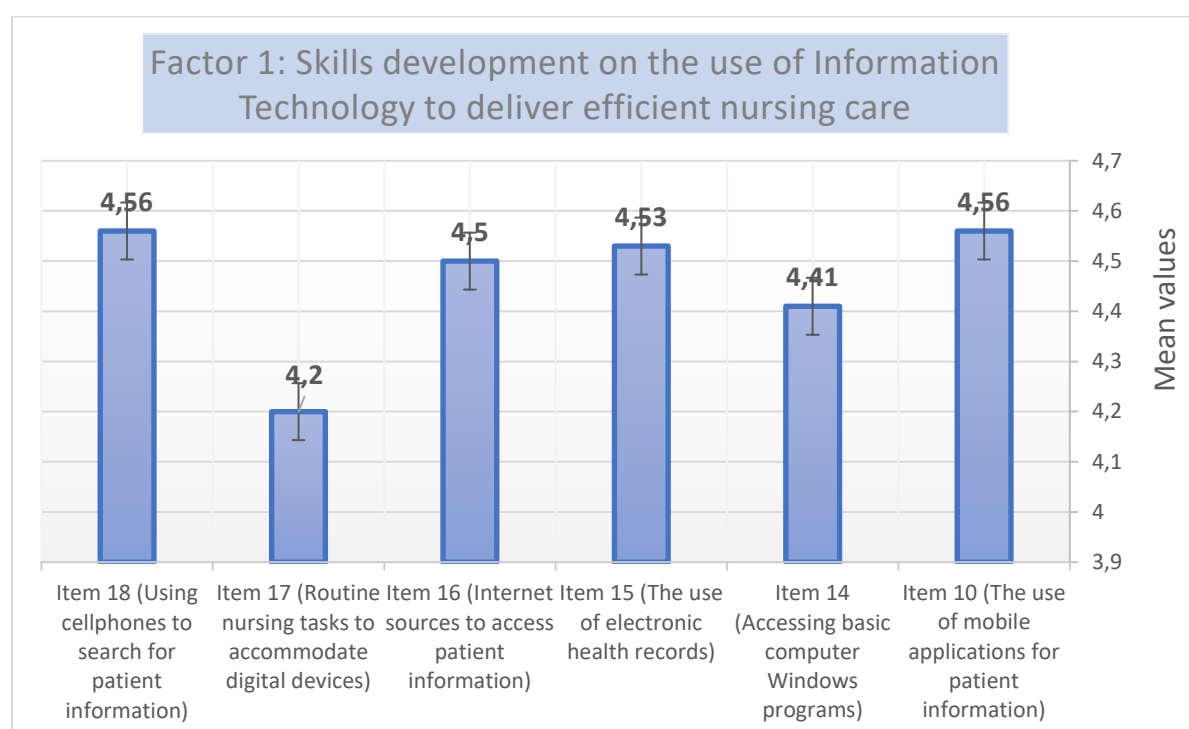


Figure 4.9: Mean values ($\bar{x}$) on skills development in the use of Information Technology to deliver efficient nursing care

Item 10: The use of mobile application technology will give nurses speedy access to patient information

In Item 10, more than two-thirds ($n=75$, 69.44%) of 108 (100.00%) senior respondents indicated their *total willingness* to use mobile application technology such as a smartphone, for the speedy access to patient information, and to contribute to the delivery of efficient nursing care (Table 4.4). Eleven ($n=11$, 10.19%) of the respondents were *totally unwilling to neutral* in their responses regarding this statement and thus indicated *not being ready* to use their mobile phones to access patient information ($\bar{x}$ 4.56, SD 0.76). A study done by Tolu-Akinnawo, Ezekwueme and Awoyemi (2024) on

telemedicine in healthcare, confirms that the use of mobile devices such as cell phones could offer healthcare workers speedy access to dependable information, and improve the delivery of efficient and effective patient-centered care.

Item 14: Nurses can access a basic computer Windows program such as Microsoft Word, Excel, or PowerPoint in preparing a patient presentation to their peers

Twelve (n=12, 11.11%) of 108 (100.00%) respondents indicated being *unwilling* to *neutral* to access a basic computer Windows program such as Microsoft Word to prepare for a patient presentation to their peers (Item 14, Table 4.4). On the other hand, more than three-quarters (n=96, 88.89%) of the respondents indicated their *total willingness* to use a Microsoft software program such as PowerPoint, to demonstrate a patient presentation to their colleagues ($\bar{x}$ 4.41, SD 0.85). Applying new technologies such as the use of computer software programs as part of teaching strategies in classrooms has led to the phenomenon of blended learning among nursing students (Ashipala, Sapalo & Shikulo, 2024). The use of Windows software programs such as PowerPoint enhances engagement and collaboration among nursing students (Lauer & Camien, 2024; Ghasemi, Moonaghi & Heydari, 2020).

Item 15: Nurses can make use of electronic health records for patients to improve patient care through means of accurate recordkeeping

In Item 15, only seven (n=7, 6.48%) of 108 (*100.02%) respondents indicated their *totally unwillingness* to *neutral* responses to use electronic health records to improve patient care through means of accurate recordkeeping, as opposed to the vast majority (n=99, 91.67%) of respondents who were *totally willing* to use electronic health records to improve patient care ($\bar{x}$ 4.53, SD 0.71) (Table 4.4). Electronic health records (EHRs) have transformed healthcare delivery and are now offering many benefits for patient care and health outcomes (Mensah, Adzakpah, Kissi et al., 2024). EHRs have notably improved patient care by improving the accessibility and accuracy of patient information (Ebberts, Takes, Smeele et al., 2024).

Significant differences between the responses of students from the different nursing programmes were found in Item 15. A third (n=20, 34.50%) of the 58 (100.00%) 3rd years, were *willing* versus a third (n=39, 78.00%) of the 50 (100.00%) 4th years, who were *totally willing* that nurses could make use of electronic health records to improve patient care, and to ensure the accuracy of healthcare records (Table 4.5).

Table 4.5: The responses of the students from the year levels on making use of electronic health records for patients as it improves patient care through means of accuracy records (Item 15)

Responses of students from the year levels (n=108)													
Year level	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean value ($\bar{x}$)
	n	%	n	%	n	%	n	%	n	%	n	%	
3 rd	0	0.00	1	0.93	0	0.00	20	18.51	29	26.85	50	46.30	4.53
4 th	1	0.93	0	0.00	5	4.63	13	12.04	39	36.11	58	53.70	

The respondents obtained a high mean value of 4.53 with a narrow distribution of the responses (SD 0.71), indicating similar responses among students in the year levels on the extent of their *readiness* to use electronic health records for patients to improve patient care through means of accuracy records (Table 4.5, Figure 4.10).

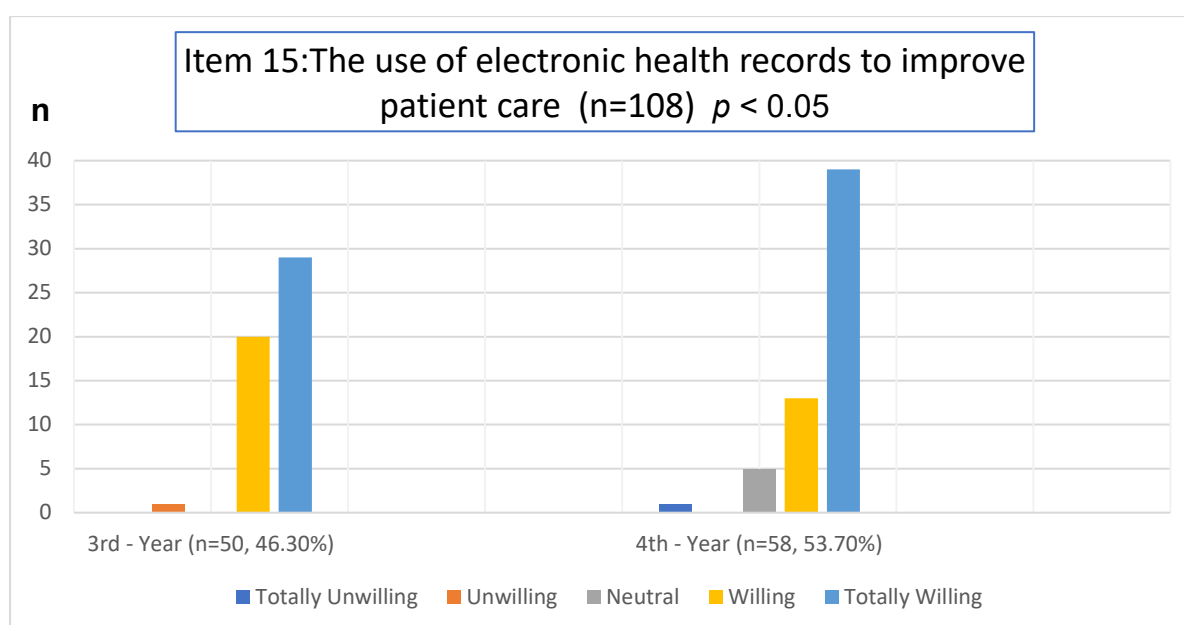


Figure 4.10: Distribution of significant differences between responses from the year levels on electronic health records to improve patient care (Item 15)

The Likelihood Ratio Test (Table 4.6) refined The Pearson's Chi-square Test and confirmed significant differences between the responses of the 3rd and 4th year students (Item 15, Figure 4.10) indicating that the 4th years were *more ready* than the 3rd year students to use electronic health records that would ensure accurate recordkeeping to improve patient care and outcomes ($\chi^2 = (4, (N = 108), 12.083, p = .0167, p < 0.05)$). The null hypothesis was rejected.

Table 4.6: Significant differences between responses of students from the year levels on electronic health records to improve patient care (Item 15)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	9.415	4	0.0515	No
Likelihood Ratio	2-sided	12.083	4	0.0167	Yes

Electronic health records (EHRs) have transformed healthcare delivery by offering many benefits for patient care and outcomes (Motsi, 2024). These records have profoundly improved patient care through the accessibility and accuracy of patient information. Therefore, nurses can easily access patient records that include the medical history of patients, leading to more informed decision-making and improved coordination of care (Adeniyi, Arowoogun, Chidi et al., 2024). The use of electronic health records (EHRs) results in better quality and safety in healthcare that is provided to patients (Park, Marquard, Austin et al., 2024; Malak & Al-Shakanbeh, 2023). EHRs improve the communication between nurses to make well-informed decisions regarding patient care as well as to ensure the safety of patients (Alomair & Pasha, 2024).

Item 16: Nurses can access internet sources to obtain patient information while working in a healthcare unit

A large majority (n=98, 90.74%) of 108 (100.00%) respondents indicated they were *totally willing* to use internet sources for patient information while working in a healthcare unit (Item 16; Table 4.4). However, a small number of ten (n=10, 9.26%) students were *totally unwilling* to *neutral* in their responses, thus indicating that they were *not willing* to use internet sources to retrieve patient information. Responses had a narrow distribution around a high mean value and indicated that the responses of students were similar, indicating their *readiness* to access internet sources for patient information ($\bar{x}$ 4.50, SD 0.75). The retrieval of patient information is much easier than before (Ning, Fan, Burgun et al., 2021). Modern medical search engines such as Medline, are providing nurses with access to important patient information by using their mobile devices such as smartphones, iPads, or laptops. The use of healthcare information systems (HISs) can improve patient care delivery by reducing medication errors, improving accessibility to patient clinical information and high-quality patient care, as well as providing more effective clinical decision-making through automated information and guidelines (Shelley et al., 2024; Tariq, Vashisht, Sinha et al., 2023).

Item 17: Routine nursing tasks such as the checking of vital signs, can be revised to accommodate more digital-orientated devices

A large majority (n=88, 81.50%) of 108 (100.00%) respondents in Item 17 indicated their *total willingness* to accommodate more digital-orientated devices and revise their routine nursing tasks, such as the checking of vital signs (Table 4.4). Less than a fifth (n=20, 18.52%) of the respondents were *totally unwilling to neutral* toward nursing duties being replaced by digital devices ($\bar{x}$ 4.20, SD 0.87). Responses had a narrow distribution around a reasonably high mean value, indicating that respondents were *ready* to accommodate digital-orientated devices. Training nurses to use digital medical devices is an important aspect of patient safety and care (Tsarfati & Cojocar, 2023). Digitalisation in the nursing sector offers many benefits such as improved workflows and more efficient communication. However, nurses need digital competencies to apply new digital tools correctly in nursing care. Acquiring digital skills in the new healthcare era allows nurses to operate digital devices and add to the hands-on approach in performing nursing duties such as checking a patient's vital signs (Wosny, Strasser & Hastings, 2024; Tischendorf et al., 2024b; Schirmer, Dalko, Stoevesandt et al., 2023).

Item 18: Nurses can use their cell phones to search for information about a patient's diagnosis

In Item 18, only seven (n=7, 6.60%) of 106 (100.00%) respondents indicated that they were *totally unwilling to neutral* to use their cell phones to search for information about a patient's diagnosis (Table 4.4). The majority (n=99, 93.40%) of the respondents indicated their *total willingness* to use their mobile devices to explore more patient information and suitable treatment options. Responses had a narrow distribution around a high mean value and indicated that respondents were similarly *ready* to access internet sources for patient information ($\bar{x}$ 4.56, SD 0.77). Mobile health applications are important tools designed to help deliver better and much-needed patient care services (Zakerabasali, Ayyoubzadeh, Baniasadi et al., 2021). Mobile health devices such as smartphones and iPads are promising approaches that can be used for accessing patient information, screening health conditions, and the treatment and management of medical conditions (Osei, Apiribu, Kissi et al., 2024).

Significant differences between the responses of students from different genders were found in Item 18.

Table 4.7: The responses of the students from different genders on using their cell phones to search for information about a patient's diagnosis (Item 18)

Responses of students from different genders (n=106)													
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values ($\bar{x}$)
	n	%	n	%	n	%	n	%	n	%	n	%	
Male	2	1.89	0	0.00	2	1.89	12	11.32	17	16.04	33	31.13	3.25
Female	0	0.00	1	0.94	2	1.89	15	14.15	55	51.89	73	68.87	

Half (n=55, 75.34%) of the 73 (100.00%) females versus only 17 (51.51%) of the 33 (100.00%) males from the 106 respondents indicated their *total willingness* to use their mobile devices such as their cell phones to search for a patient's diagnosis or treatment options (Table 4.7). The responses indicated a mean value of 3.25 with a wide distribution of the responses (SD 1.29) around the mean value, indicating that the two gender groups differed in their responses on the extent of their *readiness* to use their mobile phones to search for the diagnosis of a patient (Table 4.7) (Figure 4.11).

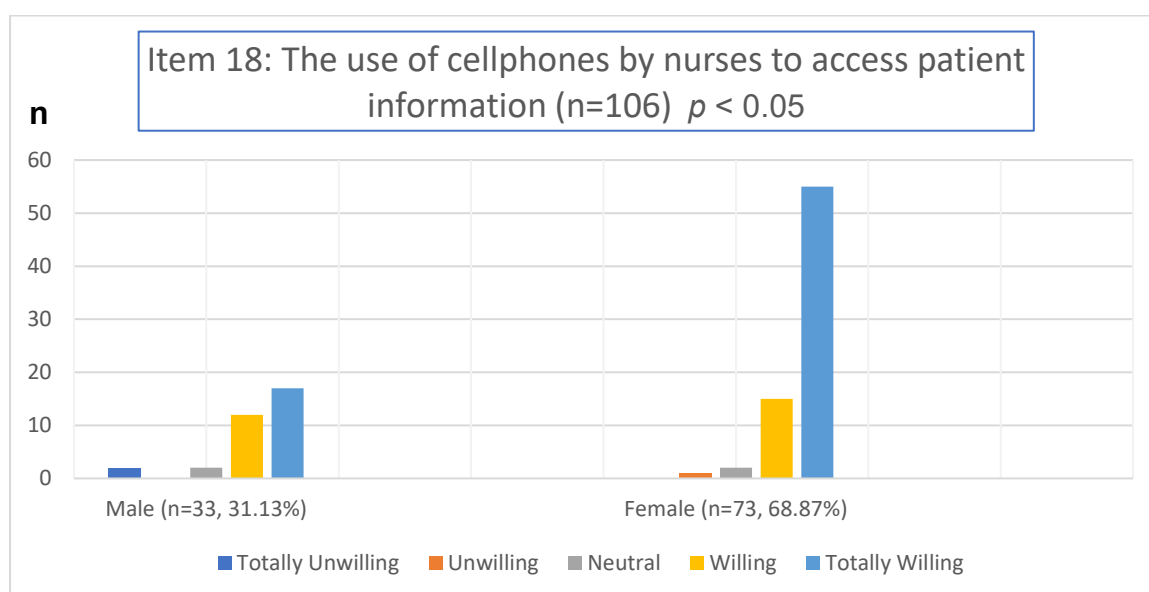


Figure 4.11: Distribution of significant differences between responses of the different genders on using cellphones to retrieve patient information (Item 18)

The Likelihood Ratio Test (Table 4.8) refined Pearson's Chi-Square Test and confirmed a significant difference between the responses of different gender respondents. Item 18 (Figure 4.11) showed that more females than male respondents indicated they were ready to use their cell phones to search for information about a patient's diagnosis and

to explore suitable treatment options ($\chi^2 = 4$, (N = 106), 10.127, $p = .0383$, $p < 0.05$). The null hypothesis was rejected.

Table 4.8: Significant differences between responses of students from different genders on using cellphones to retrieve patient information (Item 18)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	9.672	4	0.0463	Yes
Likelihood Ratio	2-sided	10.127	4	0.0383	Yes

The healthcare sector and nursing are embarking on a rapid transformation with the introduction of modern technologies such as smartphones and tablets, which are transforming the speedy accessibility of patient information (Rodríguez-Ortega, Latorre, Navarro et al., 2024). With mobile phones surpassing personal computers, an increasing number of nurses and patients are focusing on mobile health applications. Patient information materials are important tools in encouraging patients to actively participate in their nursing care decisions and to improve their general health literacy (Frølund, Løkke, Jensen et al., 2024).

Factor 1: Social and interpersonal relationships on improvements that the role of IT brings to the delivery of effective nursing care (Items 19, 23)

The descriptive statistics regarding the dimension of social and interpersonal relationships in Factor 1 indicated that the highest mean value in this factor was obtained on Item 19 ($\bar{x}$ 4.10, SD 1.03), on how the quality of the relationship between nurses and patients of different cultures could improve through digital translation applications such as Google Translate (Figure 4.12).

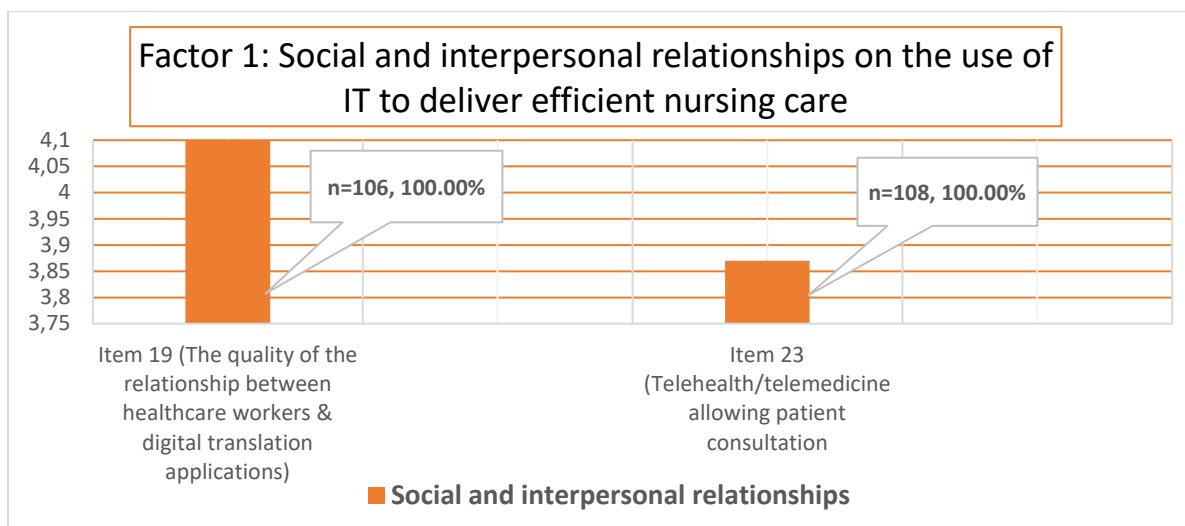


Figure 4.12: Mean values ($\bar{x}$) of social and interpersonal relationships on the use of IT to deliver efficient nursing care (Items 19, 23)

Item 19: The quality of the relationship between healthcare providers and patients of different cultures can improve through digital translation applications such as Google Translate

Nearly three-quarters ($n=78$, 72.22%) of 108 (100.00%) respondents indicated their *willingness* to use digital translation applications such as *Translators Café* to improve the quality of patient-nurse relationships. Responses were normally distributed around a normal mean value ($\bar{x}$ 4.10, SD 1.03) (Item 19, Table 4.4). However, just over a third ($n=40$, 37.04%) of the respondents were *totally unwilling to neutral* in their responses on the use of technology, where the quality of the relationship between healthcare providers and patients of different cultures could be improved through digital translation applications. Taylor and McLean (2024) emphasise the use of mobile translation applications for culturally and linguistically diverse patients during medical imaging examinations. Translation applications also improve the quality and safety of acute care and improve communication between patients and nurses to ensure more accurate procedure matching and healthcare evaluations (Lindroth, Nalaie, Raghu et al., 2024).

Item 23: Telehealth/telemedicine can allow patients to consult with doctors over long distances

Over a third ($n=39$, 36.11%) of 108 (100.00%) respondents were *totally unwilling to neutral*, versus nearly two-thirds ($n=69$, 63.99%) of respondents who indicated their *willingness* to use the method where patients could consult with doctors over long

distances, through technology applications ($\bar{x}$ 3.87, SD 1.11). The findings indicated a normal distribution of responses around the mean value, indicating that the responses of students were diverse in the extent of their readiness. Lorient, Larceneux, Guillard et al. (2024) confirm that telehealth creates remote care practices that bring several benefits to the healthcare sector such as easier access to patient care, improved communication with doctors and nurses, and greater continuity of care.

Factor 1: Knowledge of improvements that the role of IT brings to the delivery of effective nursing care (Items 26, 27, 28, 29, 35)

The mean values of Items 26, 27, 28, 29, 35 in Factor 1 indicated that the highest mean value was obtained on Item 28 ($\bar{x}$ 4.47, SD 0.81) on the use of Information Technology (IT) that can reduce paperwork currently done by nurses, and Item 29 ($\bar{x}$ 4.25, SD 0.86) on the use of smart-bed technology as an in-room monitoring tool to provide regular updates on a patient's activities such as vital signs (Figure 4.13) (Table 4.4).

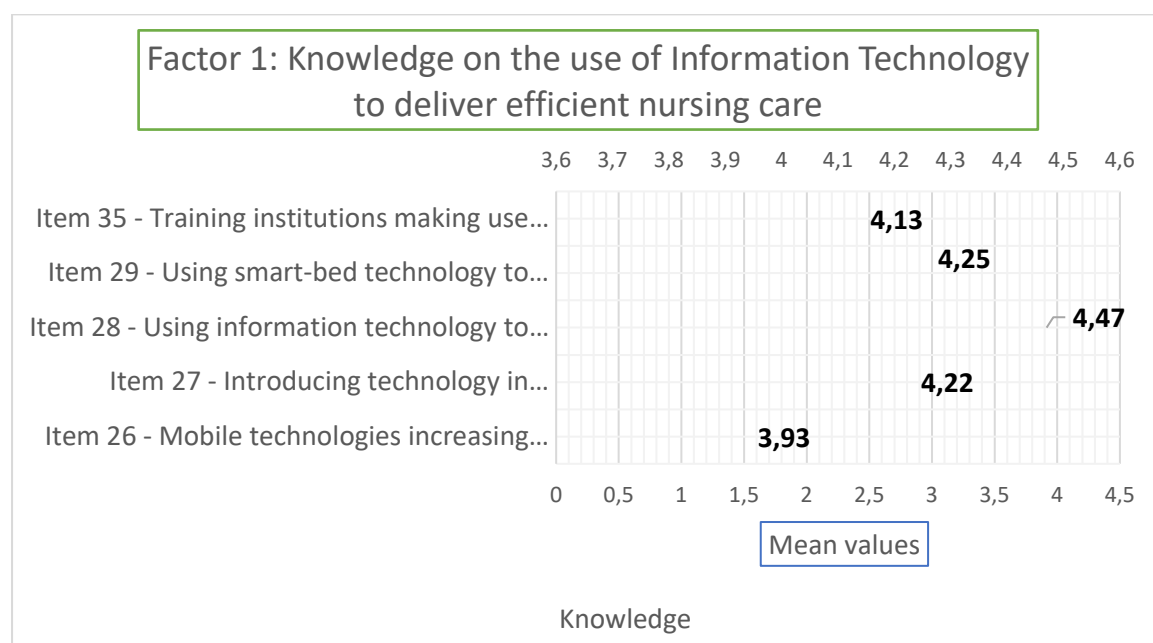


Figure 4.13: Mean values ($\bar{x}$) of the responses on knowledge regarding the use of IT to deliver efficient nursing care

Item 26: Mobile technologies can increase the number of patient admissions, leading to the earlier diagnosis and treatment of patients

In Item 26, just over two-thirds ($n=73$, 68.87%) of the 106 (99.99%) respondents indicated they were *willing to totally willing* to make use of technology-mediated

healthcare settings ($\bar{x}$ 3.93, SD 1.01) (Table 4.4). On the other hand, nearly a third ($n=33$, 31.13%) of respondents were *totally unwilling to neutral* to use mobile technologies that could increase the number of patient admissions, leading to the earlier diagnosis and treatment of medical conditions. In clinical settings, mobile technologies assist in diagnosing medical diseases, predicting patient outcomes and adjusting treatment plans. Healthcare technologies improve operational effectiveness and increase patient flow and admission (Maleki Varnosfaderani & Forouzanfar, 2024).

Significant differences between the responses of students from different genders were found in Item 26.

Table 4.9: The responses of students from different genders on the ability of mobile technologies to increase the number of patient admissions leading to earlier diagnosis and treatment (Item 26)

Responses of students from different genders (n=106)														
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values	SD
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)	
Males	3	2.83	3	2.83	6	5.67	15	14.15	6	5.67	33	31.13	3.98	0.99
Females	1	0.94	0	0.00	20	18.87	22	20.75	30	28.30	73	68.87		

**Only 106 students from 108 (100.00%) responded on Item 26, as two students did not identify themselves as either male or female*

Nearly three-quarters ($n=52$, 71.23%) of the 73 (100.00%) female respondents indicated their *total willingness* to use mobile technologies that could increase the number of patient admissions, leading to earlier diagnosis and treatment of medical conditions, versus 21 (63.63%) of the 33 (100.00%) male students (Table 4.9). The respondents ($n=106$, 99.99%) obtained a normal to reasonably high mean value of 3.98, with a normal distribution of the responses (SD 0.99) around the mean value on the extent of their *readiness* to use mobile technologies such as their cellphones, to admit patients with medical conditions for suitable treatment (Table 4.9).

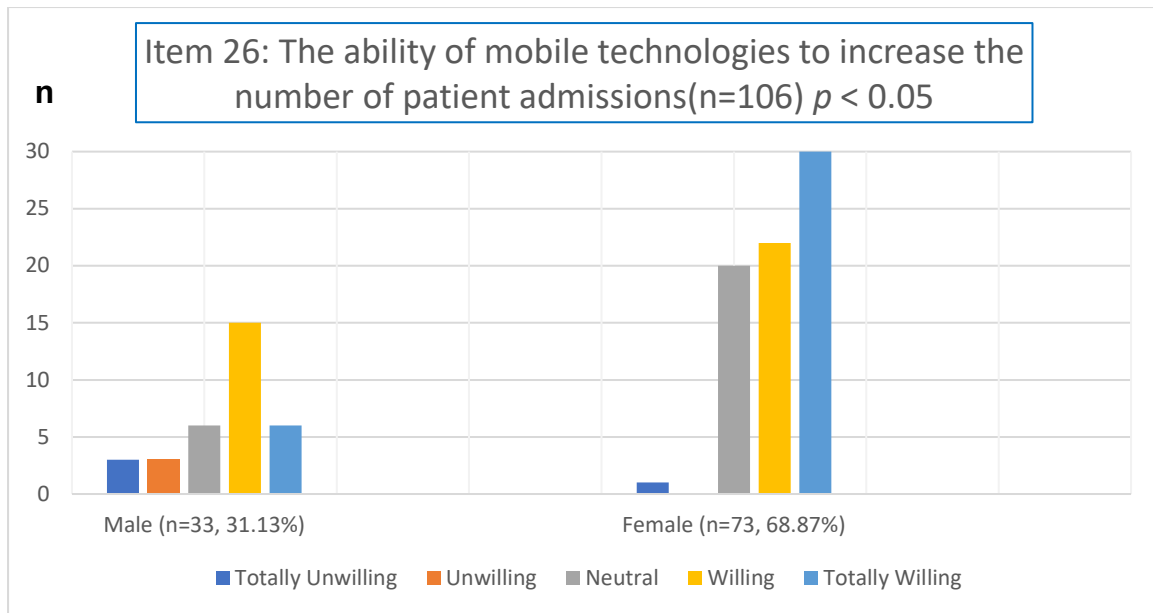


Figure 4.14: Distribution of significant differences between responses of students from different genders on the ability of mobile technologies to increase patient admissions, leading to early diagnosis and treatment (Item 26)

The Likelihood Ratio Test (Table 4.10) refined the Pearson's Chi-Square Test and confirmed a significant difference between the responses of the genders on Item 26 (Figure 4.14), as more female opposed to male respondents, were *willing* to participate in mobile technologies that could increase the number of patient admissions, that could lead to earlier diagnosis and treatment of medical conditions ($\chi^2 = (4, (N = 106), 16.482, p = .0024, p < 0.05)$). The null hypothesis was rejected.

Table 4.10: Significant differences between responses of students from the different genders on the ability of mobile technologies to increase the number of patient admissions, leading to earlier diagnosis and treatment (Item 26)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	16.055	4	0.0029	Yes
Likelihood Ratio	2-sided	16.482	4	0.0024	Yes

Worldwide, healthcare systems are experiencing difficulties in terms of infrastructure, resources and the availability of skilled healthcare workers (Zychlinski, Fluss, Goldberg et al., 2024). AI has transformed healthcare in the Healthcare 4.0 era through different technological developments. Mobile technologies such as wearable devices (smart watches) have made real-time remote patient observation more operational than ever before. It allows patient self-monitoring, increases the number of hospital

admissions and assists with the early diagnosis of medical conditions, ensuring prompt treatment measures (Sharma, Al-Wanain, Alowaidi et al., 2024).

Significant differences between the responses of students from the two nursing programmes were found in Item 26.

More than one-third (n=37, 74.00%) of the 50 (100.00%) respondents in the Bachelor of Nursing programme and 38 (65.51%) of the 58 (100.0%) respondents in the Baccalaureus of Technology in Nursing programme, indicated that they were *willing* to *totally willing* to use mobile technologies that could increase the number of patient admissions leading to earlier diagnoses of conditions, and treatment of patients (Table 4.11). Nearly a third (n=33, 30.55%) of the 108 (100.00%) respondents from both nursing programmes were *totally unwilling to neutral* to use mobile healthcare technologies when conducting patient admissions.

Table 4.11: The responses of students from the different nursing programmes on the ability of mobile technologies to increase the number of patient admissions leading to earlier diagnosis and treatment (Item 26)

Responses of students from different nursing programmes: (n=108)													
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)
BNURS	0	0.00	3	2.78	10	9.26	19	17.60	18	16.67	50	46.30	3.98
BTECH	4	3.70	0	0.00	16	14.81	19	17.60	19	17.60	58	53.70	
													0.99

Table 4.12: Significant differences between responses of students from different nursing programmes on the ability of mobile technologies to increase the number of patient admissions leading to earlier diagnosis and treatment (Item 26)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	7.862	4	0.0968	No
Likelihood Ratio	2-sided	10.535	4	0.0323	Yes

The Likelihood Ratio Test (Table 4.12) indicated a significant difference between the responses of students in the two nursing programmes (Figure 4.15), as the students in the Baccalaureus of Technology in Nursing programme were more *ready* than their peers to use mobile technologies to increase the number of patient admissions that could lead to earlier diagnosis and treatment of medical conditions ($\chi^2 = (4, (N = 108), 10.535, p = .0323, p < 0.05)$). The null hypothesis was rejected.

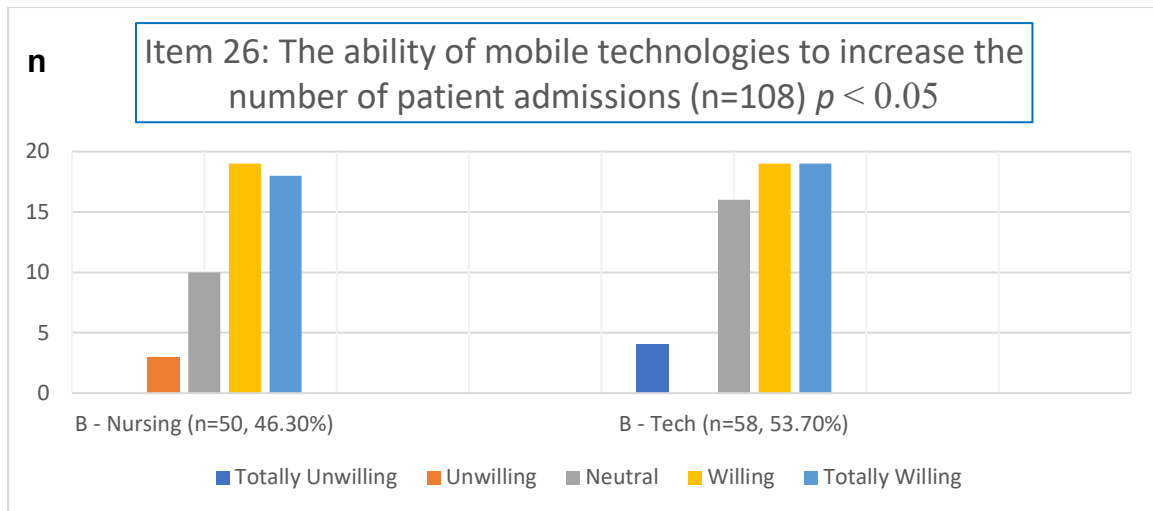


Figure 4.15: Distribution of significant differences between responses from the different nursing programmes on the ability of mobile technologies to increase the number of patient admissions leading to earlier diagnosis and treatment (Item 26)

Mobile health technologies can bring ground-breaking changes to healthcare by making it more accessible and cost-effective for patients (Gonçalves-Bradley, J Maria, Ricci-Cabello et al., 2020). The successful adoption of mobile health technologies is determined by their acceptance by healthcare workers such as nurses. However, its acceptance among nursing students who are future Professional Nurses in a new healthcare era needs to be understood as useful to help nurses monitor and trace patient information, provide patient care consultation, and increase the number of patient admissions. Mobile applications have been verified to be beneficial in covering patient care in different settings, including hospitals (Ravi, Baby, Pareek et al., 2024).

Significant differences between the responses of students in the different nursing programmes were found in Item 26.

Table 4.13: The responses of students from different nursing programmes on the ability of mobile technologies to increase the number of patient admissions leading to earlier diagnosis and treatment (Item 26)

Responses of students in the different nursing programmes: (n=108)													
Year level	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values ($\bar{x}$)
	n	%	n	%	n	%	n	%	n	%	n	%	
3 rd	0	0.00	3	2.77	10	9.25	19	17.59	18	16.66	50	46.30	3.98
4 th	4	3.70	0	0.00	16	14.81	19	17.59	19	17.59	58	53.70	
													0.99

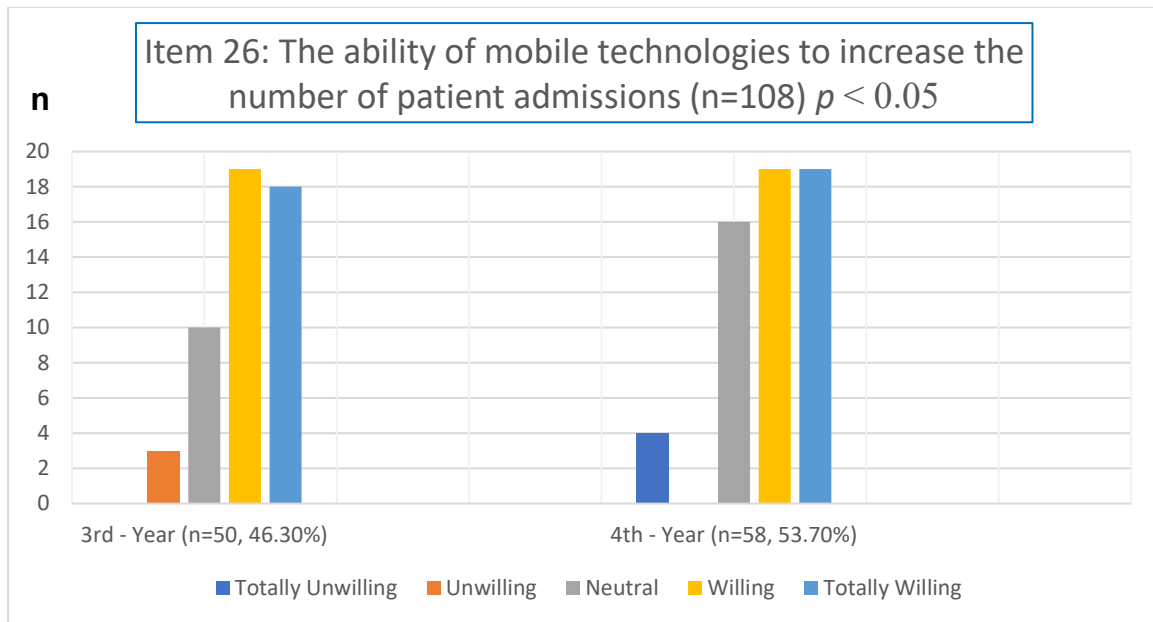


Figure 4.16: Distribution of significant differences between the responses from the different nursing programmes on the ability of mobile technologies to increase the number of patient admissions leading to earlier diagnosis and treatment (Item 26)

The Likelihood Ratio Test (Table 4.14) indicated a significant difference between the responses from the year levels in Item 26 (Figure 4.16), as 4th years indicated being slightly more unwilling (less *ready*) as 3rd years, to use mobile technologies that could increase the number of patient admissions that could lead to earlier diagnosis and treatment of medical conditions ($\chi^2 = (4, (N = 108), 10.535, p = .0323, p < 0.05)$). The null hypothesis was rejected.

Table 4.14: Significant differences between the responses of students from the different nursing programmes on the ability of mobile technologies to increase the number of patient admissions leading to earlier diagnosis and treatment (Item 26)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	7.862	4	0.0968	No
Likelihood Ratio	2-sided	10.535	4	0.0323	Yes

Classified worldwide as the frontline providers of patient care, nurses are completely benefitting from the integration of technology into healthcare (Borges do Nascimento, Abdulazeem, Vasanthan et al., 2023). Healthcare technology can empower nurses to improve their practice and redefine the patient's understanding of technology through the help of real-time patient monitoring such as smart devices. Smart devices are fitted

with technology that can continuously trace a patient's vital signs and other health parameters (Becking-Verhaar, Verweij, de Vries et al., 2023). This data is then processed to allow nurses to identify any adverse changes in a patient's condition promptly, resulting in early hospital admission and treatment of patients (Egici, Özmen Sever et al., 2024).

Item 27: The introduction of the subject Technology in nursing education programmes will benefit nursing students in their future role as Professional Nurses

In Item 27, less than a quarter (n=22, 20.37%) of 108 (100.00%) respondents were *totally unwilling to neutral* to use technology in nursing education programmes that could benefit them in their future role as Professional Nurses. On the other hand, half (n=53, 49.07%) of the respondents were *totally willing* to use digital technology that was incorporated into their nursing curricula, which could be beneficial for them as Professional Nurses to operate digital devices such as electronic health records (EHRs) in the new healthcare era of the forthcoming industries (Table 4.4). A normal distribution of responses around a high mean value was obtained ($\bar{x}$ 4.22, SD 0.94). Studies done by Knop et al. (2024) and Ng et al. (2024) indicate that the introduction of digital technology topics into the nursing education curriculum, such as patient electronic medical records, will prepare future nursing graduates for effective clinical practices.

Item 28: The use of IT can reduce the paperwork done by nurses

In Item 28, a large majority (n=93, 86.11%) of 108 (100.00%) respondents indicated their *total willingness* to use IT in their workplace, which could reduce the paperwork currently done by nurses. Only fifteen (n=15, 13.90%) of the respondents were *totally unwilling* to use and were *neutral* towards using IT in their workplace, which could reduce their workload in the workplace ($\bar{x}$ 4.47, SD 0.81) (Table 4.4). O'Connell, Barry, Hartigan et al. (2024) and Cachata, Costa, Magalhães et al. (2024), report that the use of technology-based information systems such as E-Rostering has many benefits such as reducing the paperwork that is currently done by nurses. IT also guarantees fast management of staff duty rosters, improving staff productivity, staff flexibility and reducing reliance on nursing agencies.

Significant differences between the responses of the different genders were found in Item 28.

Table 4.15: The responses of students from different genders on using IT to reduce paperwork (Item 28)

Responses of students from different genders: (n=106)														
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values	SD
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)	
Male	1	0.94	1	0.94	5	4.71	11	10.37	15	14.15	33	31.13	4.47	0.81
Female	0	0.00	0	0.00	8	7.54	12	11.32	53	50.00	73	68.87		

*Only 106 students from 108 (100.00%) responded on Item 28, as two students did not identify themselves as either male or female

Almost a quarter (n=26, 78.80%) of the 33 (100.00%) male respondents, as opposed to less than two-thirds (n=65, 89.04%) of the 73 (100.00%) female respondents, indicated their *total willingness* to use IT to reduce the paperwork currently done by nurses. Only fifteen (n=15, 14.15%) of 106 (100.00%) respondents indicated responses of *total unwillingness* to *neutral* responses on Item 28 (Table 4.15), to use electronic medical records (EMR) systems that could reduce paperwork and offer nurses quick access to patient health information.

The respondents obtained a high mean value of 4.47 with a narrow distribution of the responses (SD 0.81), indicating similar responses from the students on the extent of their *readiness* of students to use IT to reduce paperwork previously done manually by them (Table 4.15).

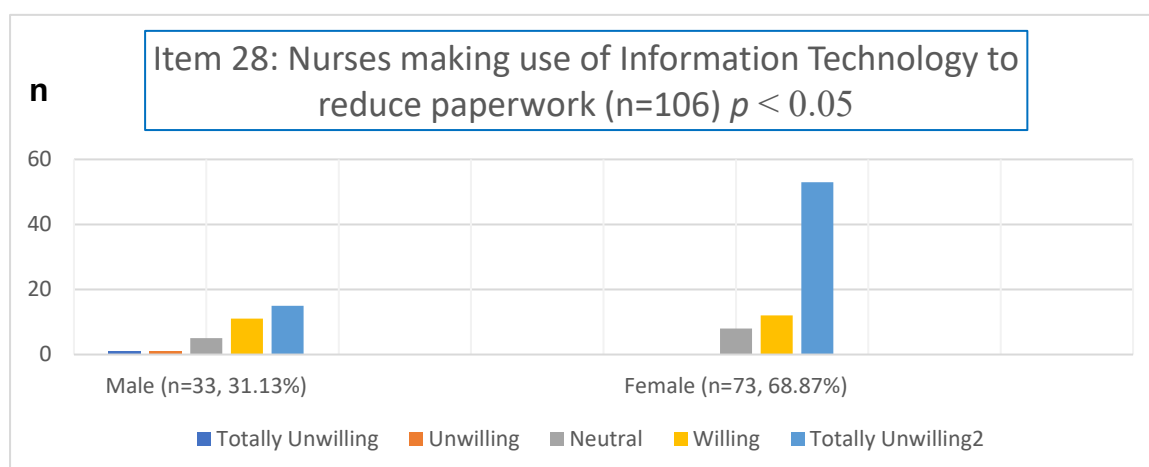


Figure 4.17: Distribution of significant differences between responses from the different genders on nurses who make use of IT to reduce paperwork (Item 28)

The Likelihood Ratio Test refined the Pearson's Chi-Square Test and confirmed a significant difference between the responses of students from different genders (Item 28, Figure 4.17; Table 4.16). More female than male respondents were *willing* to use IT in healthcare such as electronic health records, to reduce the daily nursing duties that are currently done by nurses ($\chi^2 = (4, (N = 106), 10.547, p = .0322, p < 0.05)$). The null hypothesis was rejected.

Table 4.16: Significant differences between responses of students from different genders on nurses who made use of IT, to reduce paperwork (Item 28)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	10.351	4	0.0349	Yes
Likelihood Ratio	2-sided	10.547	4	0.0322	Yes

The use of IT in healthcare such as telenursing, can help to decrease the paperwork that is presently done by healthcare workers. Telenursing can also decrease the workload of nurses by minimizing direct patient contact with negative related health after-effects. The use of IT in healthcare also offers distant healthcare and health education to patients at a very low cost (Attia Abdallah, Abdel Rahman Khamis, Ibrahim et al., 2024).

Item 29: The use of smart-bed technology such as an in-room monitoring tool could provide regular updates on a patient's activities such as vital signs

In Item 29, sixteen (n=16, 14.81%) of 108 (100.00%) respondents indicated their *total unwillingness* to *neutral* responses to use smart-bed technology such as an in-room monitoring tool, to provide them with regular updates on a patient's daily activities, such as vital signs. However, most of the respondents (n=92, 85.19%) indicated their *total willingness* to use smart-bed technology in the new era of healthcare, to monitor the progress of patients (Table 4.4). Students were similarly *ready* to e.g., use an in-room monitoring tool, as a narrow distribution of responses was found around a reasonably high mean value ($\bar{x}$ 4.25, SD 0.86). Digital tools such as smart beds in healthcare settings have the potential to improve patient care delivery and positively impact patient outcomes and staff satisfaction. Smart beds are equipped with beams that collect important information such as patients' vital signs that are analysed by a

computer and then regulated according to the bed's settings in real-time (Vitazkova, Foltan, Kosnacova et al., 2024).

Item 35: Healthcare training institutions make use of virtual reality technology such as simulation to enhance the learning experience of nurses

In Item 35, nearly three-quarters (n=86, 79.63%) of 108 (100.00%) respondents indicated they were *willing* to participate in healthcare training institutions that were making use of virtual reality technology such as simulation, that could improve the learning experience of nurses (Table 4.4). Less than a quarter (n=22, 20.37%) of 108 (100.00%) respondents were *totally unwilling to neutral* in their responses for simulation in training and healthcare institutions to be used, which could improve their learning experiences ($\bar{x}$ 4.13, SD 0.95). The use of computerised technology is growing in the classroom and healthcare settings such as hospitals (Grimwood & Snell, 2020). In nursing education, the use of virtual reality simulation has become a teaching strategy and educational tool to simulate real-life patient experiences in an unhazardous environment (Haider, Flynn & Simpson, 2024; Wolbach, Hempel & Sharif, 2024; Wong, Kwok, Leung et al., 2024; Nel, van Zyl & Labuschagne, 2021). It allows students to access recurrent practice sessions, stimulates clinical decision-making, exposes students to different patient conditions, and provides immediate feedback after a formative session with a nurse educator. Studies done by Lee and Baek (2024) and Kiegaldie and Shaw (2023) indicate that a virtual-reality-simulation-based nursing education programme not only helps nursing students to improve their learned knowledge but also to manage difficult clinical challenges.

4.3.3 Factor 2: A new approach in using IT devices requires changed perspectives in the manner that nursing care is delivered

4.3.3.1 Factor description

Factor 2 indicated that the psychological awareness of nursing students regarding a new approach to the use of IT devices required a changed perspective in delivering nursing care (Table 4.17). The overall Cronbach's Alpha (α) of Factor 2 was 0.766595.

Factor 2 addressed (i) *psychological awareness*, (ii) *skills development*, and (iii) *knowledge*.

Awareness refers to the perception or knowledge of something (Merriam-Webster.com Dictionary). Awareness is also a theory about knowing, recognising, and being aware of events.

According to Oosthuizen, Ungerer and Volschenk (2023) as well as Mwanza, Telukdarie and Igusa (2023), the new era of the forthcoming 4IR is changing the approach to how technology in the healthcare industry is understood by nursing staff.

Table 4.17: A new approach in using IT devices requiring changed perspectives in delivering nursing care

Dimensions in Factor 2	Items	Cronbach's Alpha (α) per item
Psychological awareness	1	0.7543
	2	0.7540
	3	0.7512
	8	0.7375
	9	0.7452
	11	0.7625
Skills development	24	0.7401
Knowledge	25	0.7422
	34	0.7520
	36	0.7564
	37	0.7440

Items in Table 4.17 indicate similarly high-reliability values of items in Factor 2.

(i) *Psychological awareness*

According to Stoumpos et al. (2023) as well as Cronin (2022), digital transformation in healthcare becomes the force behind how individuals or groups will think about the nursing profession (*Item 1*). The digital transformation in nursing will change the traditional methods of treatment (*Item 2*) through digital intelligence such as written programs (Aldoseri et al., 2024). According to Chang and Cho (2022), the rollout of this type of technology will initiate a trend of less physical involvement by nurses with the patient (*Item 3*).

Nurses will work with new technologies in their daily work life (*Item 8*) such as electronic duty rosters (Heydrich, Schroeder & Velten, 2023). Different skills will be required from nurses (*Item 9*) to operate digital devices in the workplace (Chipps et al., 2022). New technologies such as robots providing nursing care (*Item 11*) will

participate more actively in the workplace, such as with the delivery of meals to patients (Sommer, Kasbauer, Jakob et al., 2024; Ohneberg et al., 2023).

(ii) Skills development

Digital technologies gradually impact nursing worldwide (Wynn, Garwood-Cross, Vasilica et al., 2023). Despite the widespread developments in healthcare technology to date, the challenges in nurses' usage of digital technology remain (Horwood, Luthuli, Mapumulo et al., 2023; Isidori et al., 2022).

A study conducted by Iyanna, Kaur, Ractham et al. (2022) indicates that there is still a great concern that nurses have not kept pace with the massive changes in digital technologies, and the impact of these technologies on people. This reduces the possible benefits digital technologies can bring to nursing practices and patient care, such as the use of interactive two-way video teleconferencing in medical consultations, which can reduce the capacity of inpatient hospital stays (*Item 24*).

(iii) Knowledge

Digital developments have improved the quality of life for patients and healthcare staff (Cuff, 2023). Digital literacy is gradually being used by people and is therefore becoming an important prerequisite for students, nurse lecturers, patients, and other healthcare workers (Tegegne et al., 2023). Studies conducted by Kerimbayev, Umirzakova, Shadiev et al. (2023) as well as Gause et al. (2022), indicate the importance of HEIs to nurture and support nursing training programmes that are both advanced and developed by digital technology.

The nursing profession needs to change its practices of digital technology by supporting nurses to become educated and informed in the use of IT (Isidori et al., 2022). Therefore, it becomes important to assess the digital literacy of nursing students at their entry level to establish their competency in using digital technologies (Harerimana, Duma & Mtshali, 2022). It has become an important skill in the healthcare profession that is needed to improve high-quality patient care (*Item 25*). According to Chung (2023 and Haleem, Javaid, Qadri et al. (2022), nurses in the new healthcare era require a higher level of education when working with digital devices or machines in healthcare settings (*Item 34*).

Although healthcare settings that are making use of digital devices need a reduced number of nursing staff than previously (*Item 36*), technology can also threaten the important patient-nurse relationship e.g., patients can rely on nurses to explain how to use their medication, monitor their vital signs, and provide emotional support that cannot be done with technology (Hack-Polay et al., 2023; Jongsma, Bekker, Haitjema et al., 2021). However, digital technology in healthcare settings such as robotic surgery, offers many benefits to patients versus open surgery e.g., a shorter stay in the hospital, an earlier recovery period, and for patients to return to their normal activities (Bramhe & Pathak, 2022). The drive towards robotic surgery creates an environment of helping more patients over a shorter period (*Item 37*).

4.3.3.2 Factor 2: Findings on using IT devices requiring changed perspectives

Factor 2 addressed a new approach to using IT devices requiring changed perspectives in delivering nursing care, that is addressed under the sections of (i) psychosocial awareness (ii) skills development and (iii) knowledge.

An overall view of the distribution of the mean values of the three dimensions in Factor 2 is outlined in Figure 4.19. Respondents indicated a more negative response towards readiness was in the dimension of psychological awareness (Items 3, 11). Item 3 indicated that 71 (65.73%) of the respondents were *totally unwilling to neutral* that robots could replace nursing duties such as the lifting of patients out of bed ($\bar{x}$ 3.08, SD 1.08), and had the lowest mean value in Factor 2.

Similarly, in Item 11 (Figure 4.19), respondents were also *totally unwilling to neutral* that new technologies such as robotic nursing care could participate more actively in the workplace, with a mean value of ($\bar{x}$ 3.19, SD 1.34). Students were diverse in their responses to the extent of their *readiness* to use robots in nursing duties.

The responses of students on *psychological awareness* indicated between slightly low to high mean values ($\bar{x}$ 3.08 - 4.22), with a narrow to normal distribution of responses (SD 0.81 - 1.01) of students around the mean values.

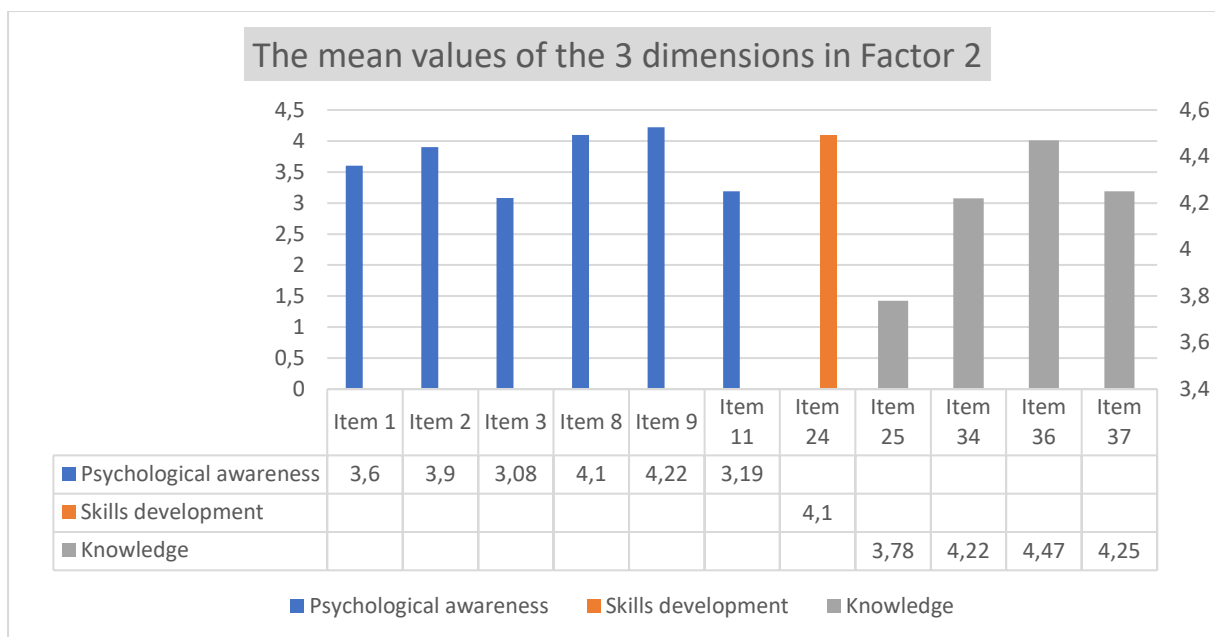


Figure 4.18 Mean values ($\bar{x}$) of items in Factor 2 on a new approach to using IT devices requiring changed perspectives in delivering nursing care (Factor 2)

Factor 2: Psychological awareness of a new approach to using IT devices
 requiring changed perspectives in delivering nursing care (Items 1, 2, 3, 8, 9, 11)

The descriptive statistics regarding the dimension of psychological awareness in Factor 2 indicated that the highest mean values were obtained on Item 8 ($\bar{x}$ 4.10, SD 1.04) that nurses can employ new technologies in their daily work life such as the use of electronic duty rosters, and on Item 9 ($\bar{x}$ 4.22, SD 0.81) that different skills will be required to operate digital devices in the workplace (Table 4.18, Figure 4.18).

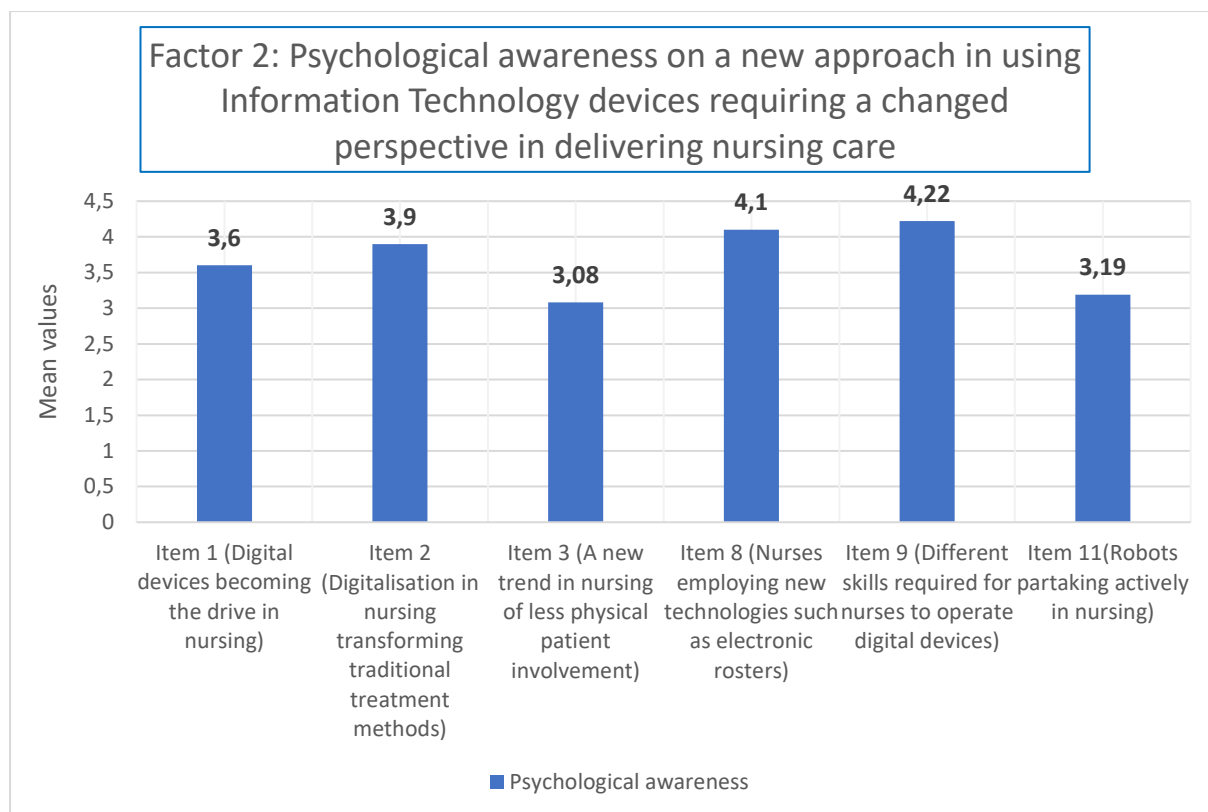


Figure 4.19: Mean values ($\bar{x}$) on psychological awareness on a new approach in using Information Technology devices requiring a changed perspective in delivering nursing care (1, 2, 3, 8, 9, 11)

Item 1: Digital devices will become the drive behind how individuals or groups think about the nursing profession

In Item 1, more than half ($n=57$, 52.77%) of 108 (100.00%) respondents were *totally willing* to use digital devices that would become the drive behind how individuals or groups think about the nursing profession, versus nearly half of the respondents ($n=51$, 47.22%) who were *totally unwilling to neutral* in using digital devices in the workplace ($\bar{x}$ 3.60, SD 0.85) (Table 4.18). A study done by Alenezi, Alshammari and Ibrahim (2024) confirms the statement that digital devices will become the driving force in how healthcare workers, especially nurses, will think about their profession.

Item 2: Digitalisation in nursing will transform the traditional methods of treatment through digital intelligence such as written programs

In Item 2, nearly three-quarters ($n=78$, 72.22%) of 108 (100.00%) respondents indicated their *willingness* to participate in digitalisation in nursing and to use digital devices that could transform the traditional methods of treatment through digital intelligence such as written programs (Table 4.18). Comparably, just over a quarter

(n=30, 27.78%) of the respondents were *totally unwilling to neutral* in their responses that traditional treatment options could be transformed and replaced using digital intelligence ($\bar{x}$ 3.90, SD 0.94).

The healthcare sector needs to use digital technology for ground-breaking results to improve healthcare delivery and to achieve improvement in medical problems (Junaid, Imam, Balogun et al., 2022). The digital transformation of healthcare includes changes related to the internet, digital technologies, and their relation to new treatment options, and best practices for better health management procedures. (Wong, Vengusamy & Bastrygina, 2024).

Item 3: A trend in the field of nursing will happen where there will be less physical involvement with the patient

In Item 3, just over a third (n=37, 34.26%) of 108 (100.00%) respondents were *totally willing* and indicated to use digital technologies such as robotic nursing care that would require less physical involvement with the patient (Table 4.18). Just less than two-thirds (n=71, 65.73%) of the respondents indicated that they were *totally unwilling to neutral* to make use of robots that would replace nursing duties such as the lifting of patients out of bed ($\bar{x}$ 3.08, SD 1.08). A study done by Deo and Anjankar (2023) on robotic nursing care indicates that the burden of staff shortages will be replaced by robots and will result in less physical involvement with patients.

Item 8: Nurses employ new technologies in their daily work life such as electronic duty rosters

In Item 8, just over three-quarters (n=83, 76.85%) of 108 (100.00%) respondents indicated their *total willingness* to use new technologies in their daily work life such as electronic duty rosters (Table 4.18). Less than a quarter (n=25, 23.14%) of the respondents were *totally unwilling to neutral* regarding using electronic duty rosters as part of their daily work activities that would allow them to focus more on nurse-patient interaction ($\bar{x}$ 4.10, SD 1.04). Arefin (2024), in a study conducted on digitalisation in healthcare, indicates the willingness of nurses to adopt technology in their daily duties such as recordkeeping.

Technology is becoming an important key enabler for the improvement of healthcare quality (Osama, Ateya, Sayed et al., 2023). The use of technology-based information systems such as electronic rostering (e-Rostering) has many benefits for the nursing

sector such as cost-effectiveness and the speedy processing of staff rosters. E-rostering allows the accurate planning of healthcare staff requirements to improve the delivery of high-quality patient care (O'Connell et al., 2024).

Item 9: Different skills will be required by nurses to operate digital devices in the workplace

In Item 9, more than three-quarters (n=91, 84.26%) of 108 (100.00%) respondents indicated their *total willingness* to acquire different skills to use digital devices in their workplace (Table 4.18). Only 17 (15.74%) of the respondents were *totally unwilling to neutral* towards using different skills that must be obtained to operate digital devices in their workplaces ($\bar{x}$ 4.22, SD 0.81). Responses indicated that students were more similar in the extent of their *readiness* to operate digital devices in the workplace.

The use of data, information, and technology in healthcare should be mastered by all nurses to allow them to use technology and devices to provide high-quality nursing and patient care in the new healthcare era of the forthcoming industries. However, more training in the use of digital technology is required to prepare and empower the future healthcare workforce (Dykes & Chu, 2020). A digitally empowered profession guarantees not only high-quality healthcare for patients but also lengthens the benefits of patient care, including better outcomes for patients (Syed-Abdul & Li, 2023). Studies done by Tischendorf et al. (2024a) and Ng, Leung, Su et al. (2023), indicate that nursing professionals need to attain the much-needed digital competencies to correctly apply new digital tools in healthcare (Item 9).

Item 11: New technologies such as robots that could provide nursing care will participate more actively in the workplace

In Item 11, just less than half (n=45, 41.66%) of 108 (100.00%) respondents were *totally willing* to make use of new technologies such as robots that could provide nursing care and could participate more actively in the workplace (Table 4.18). Less than two-thirds (n=63, 58.32%) of the respondents were *totally unwilling to neutral* in their responses to the use of robots in their workplace that could render nursing duties such as the distribution of meals to patients (Table 4.18). Respondents differed in their responses (SD 1.34) on the extent of their *readiness* to provide nursing care with robots, as a wide distribution of responses around the mean value was obtained in Item 11 ($\bar{x}$ 3.19).

Technology integration into healthcare has shown its potential to improve nursing care by reducing medical errors and improving patient care quality (Alawiye, 2024). Using new technologies such as robots in nursing improves treatment, diagnosis, and care practices (Soriano et al., 2022). Robotic nursing care can help with patient transportation and welfare services such as counseling and feeding (Mahmoudi & Moradi, 2024).

Significant differences between the responses of students from the year levels were found in Item 11.

Table 4.18: The responses of students from the different nursing programmes on new technologies such as robots that will provide nursing care and participate more actively in the workplace (Item 11)

Responses from students in the different nursing programmes (n=108)														
Year level	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean value	SD
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)	
3 rd	2	1.85	6	5.55	15	13.88	12	11.11	15	13.88	50	46.30	3.19	1.34
4 th	14	12.96	10	9.25	16	14.81	9	8.33	9	8.33	58	53.70		

A quarter (n=27, 54.00%) of the 50 (100.00%) junior respondents in the 3rd year level, versus only 18 (31.03%) of the 58 (100.00%) senior respondents in the 4th year, indicated their *total willingness* to use new technologies such as robots to provide nursing care to patients such as with the distribution meals (Table 4.19). However, more than a third (n=40, 68.96%) of the respondents in the 4th year indicated their *total unwillingness* to be *neutral* responses that robots could replace nurses and carry out daily duties such as bed washes and the distribution of meals.

The responses of all respondents obtained a mean value of 3.19 with a wide distribution of the responses (SD 1.34) around the mean value, indicated a diversity of responses among students on the extent of their readiness to be replaced by robotic nursing care, where robots will actively perform duties currently done by nurses (Table 4.19).

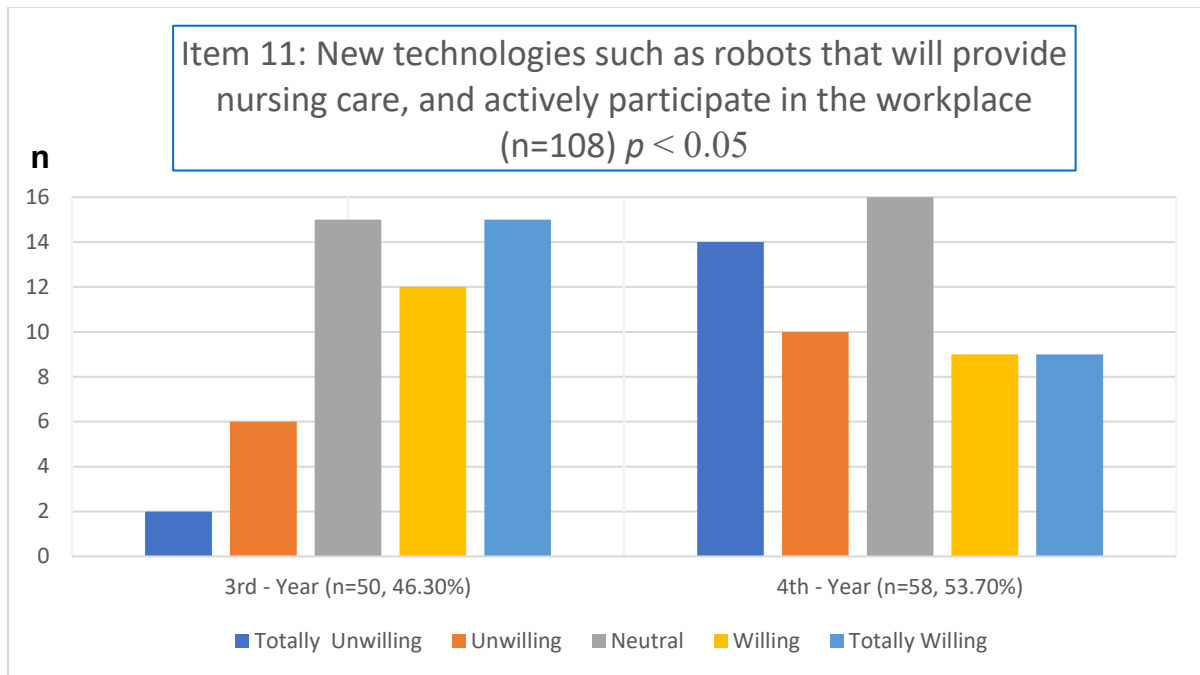


Figure 4.20: Distribution of significant differences between responses of the year levels on new technologies such as robots that will provide nursing care and participate more actively in the workplace (Item 11)

The Likelihood Ratio Test refined the Pearson's Chi-Square Test and confirmed a significant difference between the year-level responses on Item 11 (Figure 4.20; Table 4.20) indicating a high *unwillingness* response rate of the senior students in 4th-year to use new technologies such as robots that could participate actively in the daily chores of nurses such as the distribution of meals to patients ($\chi^2 = (4, (N = 108), 12.52, p = .0139, p < 0.05)$). The null hypothesis was rejected.

As people get older, their ability to perform basic self-care activities can be reduced because of the occurrence of cognitive and physical weakening (Melchiorre, Socci et al., 2024). As a result, these individuals can feel frustrated and helpless. They start to lose their motivation for self-care because of emotional or environmental reasons.

Table 4.19: Significant differences between responses of students from the year levels on new technologies such as robots that will provide nursing care and participate more actively in the workplace (Item 11)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	11.431	4	0.0221	Yes
Likelihood Ratio	2-sided	12.52	4	0.0139	Yes

Currently, different robotic systems have been created to help individuals with different physical disabilities (Trainum, Liu, Hauser et al., 2024). *Significant differences between the responses* of the different nursing programmes were found in Item 11.

Table 4.20: The responses of students from the different nursing programmes on new technologies such as robots that will provide nursing care and will participate more actively in the workplace (Item 11)

Responses of students from the different nursing programmes: (n=108)														
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values	SD
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)	
BNURS	2	1.85	6	5.55	15	13.88	12	11.11	15	13.88	50	46.30	3.19	1.34
BTECH	14	12.96	10	9.25	16	14.81	9	8.33	9	8.33	58	53.70		

A quarter (n=27, 54.00%) of 50 (100.00%) respondents in the Bachelor of Nursing programme and eighteen (n=18, 31.03%) of 58 (100.00%) respondents in the Baccalaureus of Technology in Nursing programme (Table 4.21), indicated their *total willingness* in their responses and indicated to use new technologies such as robotic nursing care that would participate more actively in the workplace by assisting with the distribution of meals to patients. Less than two-thirds (n=63, 58.33%) of respondents in both the nursing programmes who were *totally unwilling to neutral* in their responses indicated not to use robots that will replace nurses to deliver daily nursing duties such as feeding patients.

The respondents obtained a low mean value of 3.19 with a wide distribution of responses (SD 1.34) that indicated that students had diverse responses on the extent of their *readiness* to be replaced by robots that will perform all the duties previously done by them (Table 4.21).

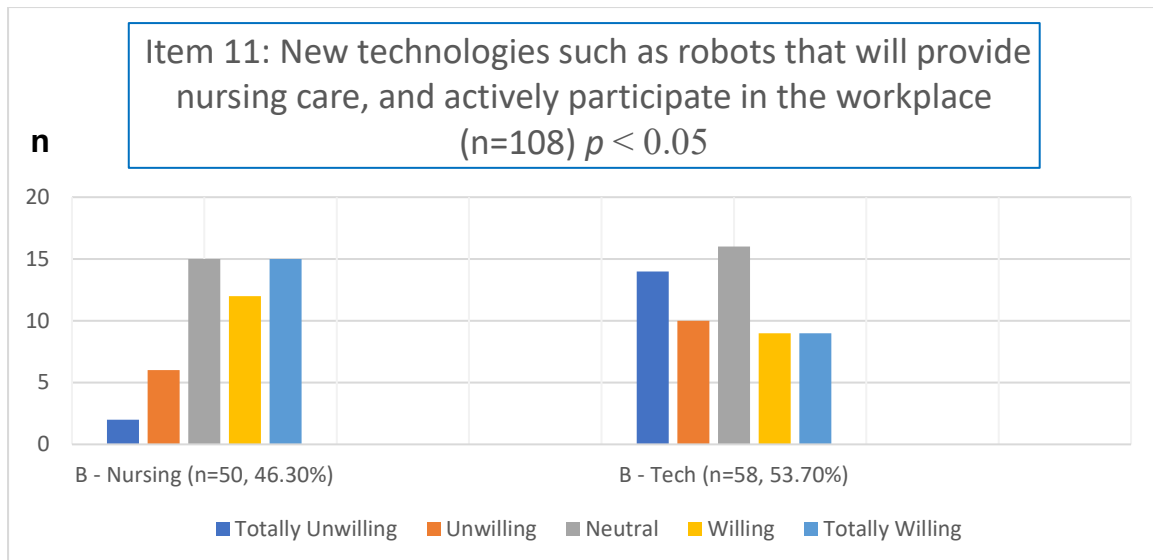


Figure 4.21: Distribution of significant differences between responses from the different nursing programmes on new technologies such as robots that will provide nursing care and will participate more actively in the workplace (Item 11)

The Likelihood Ratio Test refined the Pearson's Chi-Square Test and confirmed a significant difference between the responses of students from the different programmes (Item 11, Figure 4.21; Table 4.22) on their willingness to let their daily nursing tasks such as the feeding of patients be replaced by robotic nurses that will be more active in the workplace than the current nurses ($\chi^2 = (4, (N=108), 12.52, p = .0139, p < 0.05)$). The null hypothesis was rejected.

Table 4.21: Significant differences between responses of students from the different nursing programmes on new technologies such as robots that will provide nursing care and will participate more actively in the workplace (Item 11)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	11.431	4	0.0221	Yes
Likelihood Ratio	2-sided	12.52	4	0.0139	Yes

The use of robotic nursing care equipment is an essential choice for solving the shortage of healthcare workers, but the outcomes of its introduction have not been fully evaluated (Li, Wang, Wang et al., 2024). Face-to-face care can still be offered by nurses using robotic nursing care equipment. However, the use of some robot technologies might be able to decrease the workload of healthcare workers and improve the efficiency of caregiving tasks (Yoshimi, Kato, Aimoto et al., 2024).

Factor 2: Skills development on a new approach in using IT devices requiring changed perspectives in delivering nursing care (Item 24)

In the dimension of skills development, Item 24 addressed how the use of interactive two-way video teleconferencing in medical consultations will reduce the volume of inpatient hospital visits ($\bar{x}$ 4.10, SD 1.03) (Table 4.18). If a factor has one (1) item, it is not seen as a factor, but the item is described. For purposes of this study, the factor was included as it pointed out a dimension of the conceptualisation.

Item 24: The use of interactive two-way video teleconferencing in medical consultations could reduce the volume of inpatient hospital visits

In Item 24 (Table 4.18), less than three-quarters ($n=78$, 72.22%) of 108 (100.00%) respondents indicated their *total willingness* to use interactive two-way video teleconferencing in medical consultations, which could reduce the volume of inpatient hospital visits ($\bar{x}$ 4.10, SD 1.03). However, just over a third ($n=40$, 37.04%) of the respondents were *totally unwilling to neutral* in their responses to using interactive two-way video teleconferencing in medical consultations ($\bar{x}$ 4.10, SD 1.03).

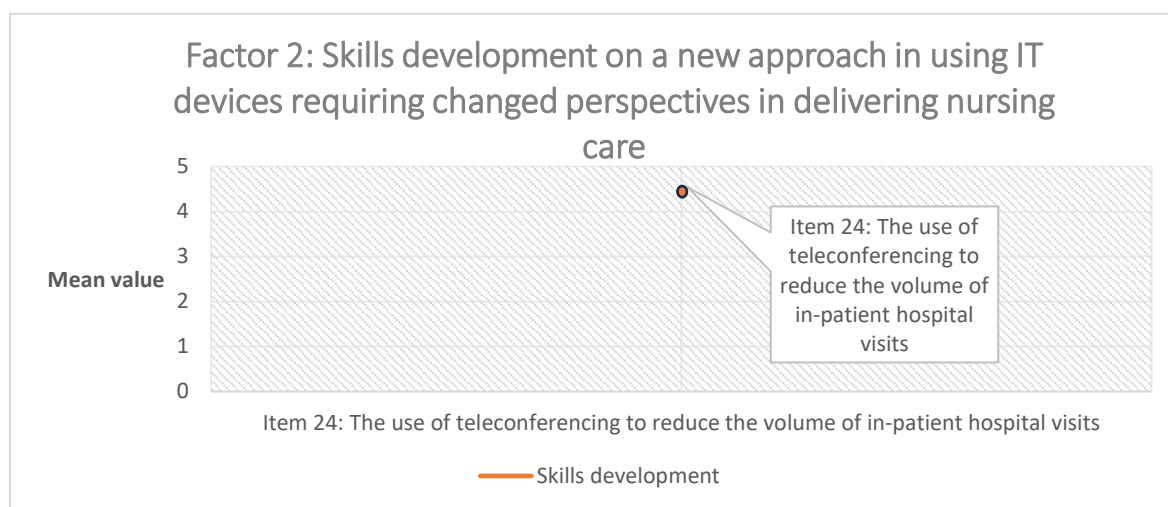


Figure 4.22: Mean value ($\bar{x}$) on skills development in using a new approach in using IT devices, requiring a changed perspective in delivering nursing care (Item 24)

Bowles, Trentino, Lloyd et al. (2024) indicate that technological developments such as telehealth will allow important digital transformation of healthcare delivery, where on average, a telehealth visit and consultation will reduce the number of future outpatient visits.

Significant differences between the responses of students from the different home languages were found in Item 24.

Table 4.22: The responses of students from the different home languages on using interactive two-way video teleconferencing in medical consultations to lessen the volume of inpatient hospital visits (Item 24)

Home language responses of respondents (n=108)														
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values	SD
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)	
Eng	0	0.00	0	0.00	2	1.85	1	0.92	6	5.55	9	8.33	3.78	1.12
Afr	1	0.92	4	3.70	4	3.70	0	0.00	4	3.70	13	12.03		
Xhosa	2	1.85	6	5.55	14	12.96	24	22.22	19	17.59	65	60.18		
Zulu	0	0.00	2	1.85	1	0.92	1	0.92	4	3.70	8	7.40		
Other	0	0.00	2	1.85	1	0.92	7	6.48	3	2.77	13	12.03		
Total	3	2.77	14	12.95	22	20.35	33	30.54	36	33.31	108	99.97		

More than a third (n=43, 66.15%) of 65 (100.00%) Xhosa-speaking respondents, and ten (n=10, 47.61%) from 21 (100.00%) respondents from other African languages, indicated their *total willingness* to use interactive two-way video teleconferencing in medical consultations that could lessen the volume of inpatient hospital visits (Table 4.23). Less than a quarter (n=22, 33.84%) of 65 (100.00%) Xhosa-speaking respondents were *totally unwilling* to *neutral* to use interactive two-way video teleconferencing during medical consultations that could lessen the volume of inpatient hospital visits. Seventeen (15.74%) of 108 (100.00%) respondents in all home language groups were *totally unwilling* to *neutral* to use teleconferencing that could reduce the influx of patients to healthcare facilities. The responses indicated a mean value of 3.78, with a high distribution of the responses (SD 1.12) around the mean value on the extent of *readiness* of students to use video teleconferencing during patient consultations, to reduce hospital admissions (Table 4.23).

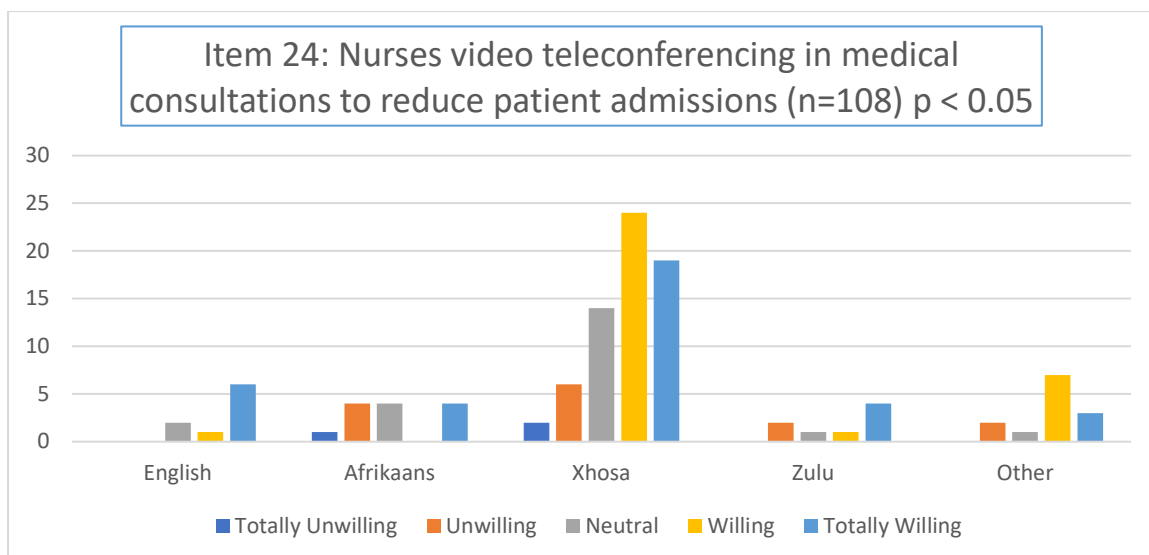


Figure 4.23: Distribution of significant differences between responses of students from the different home languages on nurses using two-way video teleconferencing in medical consultations to reduce patient admissions (Item 24)

The Likelihood Ratio Test found a significant difference between the home language responses on Item 24 (Figure 4.23; Table 4.24), that the Xhosa-speaking respondents were more *willing* than the other African languages to use healthcare technology such as video teleconferencing to lessen the high volume of patient admissions ($\chi^2 = 16$, (N = 108), 27.815, $p = .0333$, $p < 0.05$). The null hypothesis was rejected.

Table 4.23: Significant differences between responses of students in the different home languages on nurses using interactive two-way video teleconferencing in medical consultations to lessen the volume of inpatient hospital visits (Item 24)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	23.541	16	0.1	No
Likelihood Ratio	2-sided	27.815	16	0.0333	Yes

Mobile health applications such as telehealth have allowed important digital transformation of healthcare delivery (Mbunge, Batani, Gaobotse et al., 2022). These applications allow patients to consult with healthcare workers via e-visits and have many benefits for healthcare workers and patients, such as the facilitation of medical consultations through two-way teleconferencing and reducing the number of future outpatient visits (Sharma, Feldman & Sharma, 2024; Ayabakan, Bardhan & Zheng, 2023).

Factor 2: Knowledge of a new approach in using Information Technology devices requiring changed perspectives in delivering nursing care (Items 25, 34, 36 & 37)

The mean values of Items (Items 25, 34, 36, 37) in the dimension of knowledge in Factor 2 indicated that the highest mean values were obtained in Item 36 ($\bar{x}$ 4.47, SD 0.81), on how nursing units that are making use of digital devices will require fewer nursing staff than in the past, and in Item 37 ($\bar{x}$ 4.25, SD 0.86) on how the movement towards robotic surgery will create an environment of assisting more patients in a shorter period. (Table 4.18). The items in the dimension of *knowledge* of the students had the highest mean values ($\bar{x}$ 4.25 - 4.47) with a narrow distribution of responses (SD) around their mean values.

Table 4.24: Descriptive statistics on Factor 2: A new approach in using IT devices requiring changed perspectives in delivering nursing care

Items	As a nursing student, I am willing (ready) to participate in the digital changes emerging in healthcare, because...	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		(x̄)	SD
		1		2		3		4		5					
		n	%	n	%	n	%	n	%	n	%	n	%		
Psychological awareness															
1	digital devices become the drive behind how we as individuals, or in groups, will think about the nursing profession.	2	1.85	4	3.70	45	41.67	41	37.96	16	14.81	108	100.00	3.60	0.85
2	digitalisation in nursing transforms the traditional methods of treatment through digital intelligence e.g., written programs.	3	2.78	4	3.70	23	21.30	48	44.44	30	27.78	108	100.00	3.90	0.94
3	A trend in the field of nursing will occur of less physical involvement with the patient.	9	8.33	21	19.44	41	37.96	26	24.07	11	10.19	108	100.00	3.08	1.08
8	nurses employ new technologies in their daily work life such as electronic duty rosters.	4	3.70	4	3.70	17	15.74	35	32.41	48	44.44	108	100.00	4.10	1.04
9	Different skills will be required to operate digital devices in the workplace.	1	0.93	2	1.85	14	12.96	46	42.59	45	41.67	108	100.00	4.22	0.81
11	new technologies such as robots providing nursing care, will participate more actively in the workplace, such as e.g., with the distribution of meals to patients.	16	14.81	16	14.81	31	28.70	21	19.44	24	22.22	108	100.00	3.19	1.34
Skills development															
24	The use of interactive two-way video teleconferencing in medical consultations lessening the volume of inpatient hospital visits.	2	1.85	8	7.41	30	27.78	27	25.00	51	47.22	108	100.00	4.10	1.03
Knowledge															
25	Information Technology in healthcare is needed to improve high-quality patient care.	3	2.78	14	12.96	22	20.37	33	30.56	36	33.33	108	100.00	3.78	1.12
34	Future nurses require a higher level of education when operating digital devices or machines in healthcare settings, as currently.	2	1.85	3	2.78	17	15.74	33	30.56	53	49.07	108	100.00	4.22	0.94
36	Nursing units making use of digital devices require fewer nursing staff than in the past.	1	0.93	1	0.93	13	12.04	24	22.22	69	63.89	108	100.00	4.47	0.81
37	The movement towards robotic surgery creates an environment of assisting more patients in a shorter period.	2	1.85	2	1.85	12	11.11	42	38.89	50	46.30	108	100.00	4.25	0.86

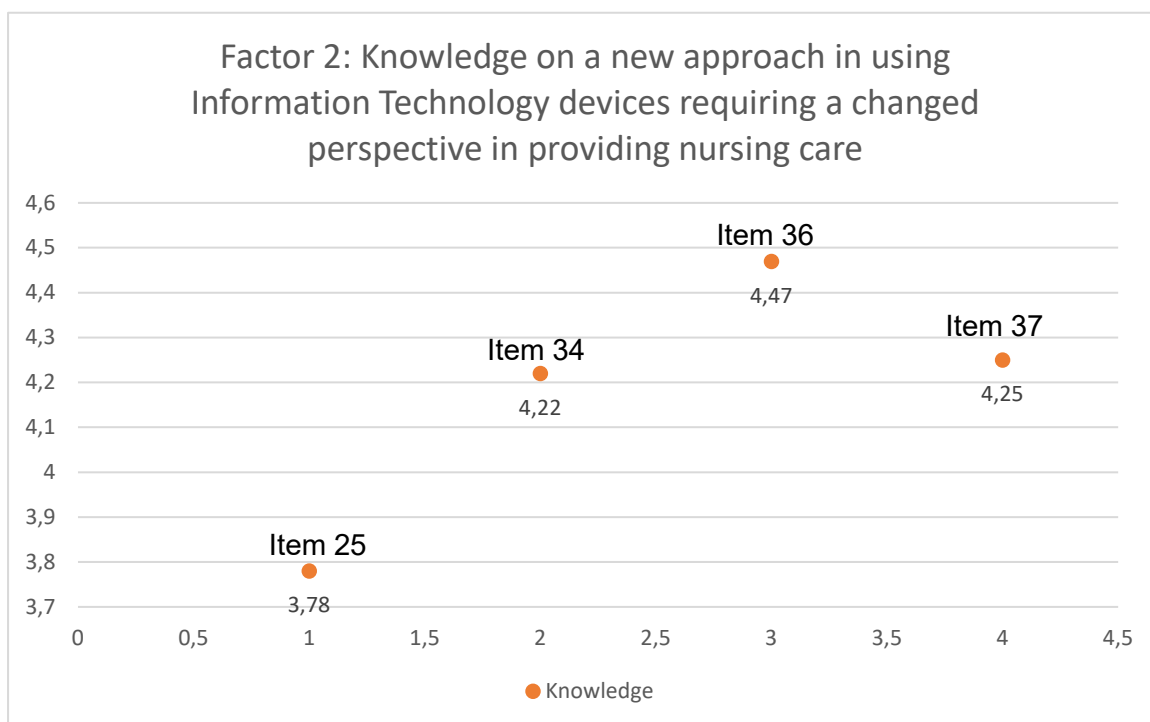


Figure 4.24: Mean values ($\bar{x}$) on knowledge of a new approach in using IT devices requiring a changed perspective in delivering nursing care (Items 25, 34, 36, 37)

Item 25: Information Technology in healthcare settings is needed to improve high-quality patient care

In Item 25, less than two-thirds ($n=69$, 63.89%) of 108 (100.00%) respondents indicated their *total willingness* to use IT in healthcare settings to improve high-quality patient care (Table 4.24), versus just a third ($n=39$, 36.11%) of respondents who were *totally unwilling to neutral* to use Information Technology and digital literacy that were skills needed in the new era of healthcare to provide high-quality patient care. Students had diverse responses on the extent of their *readiness* for the use of digital literacy needed to provide high-quality patient care ($\bar{x}$ 3.78, SD 1.12).

Studies conducted by Laakkonen, Jarva, Hammarén et al. (2024) and Smith, Horne and Wei (2024) confirm this statement that technical competence and the use of IT in healthcare settings are prerequisites in the new era of healthcare to provide high-quality nursing and patient care. Abo Elmagd and Alharbi (2024) conducted a quantitative study on nursing students' willingness to accept the use of digital technology in healthcare settings. The findings of the study highlight the positive

attitude of undergraduate nursing students toward accepting IT usage in healthcare settings.

Item 34: Future nurses will require a higher level of education when operating digital devices or machines in healthcare settings, as they are currently doing

In Item 34, more than three-quarters (n=86, 79.63%) of 108 (100.00%) respondents were *totally willing* to use digital devices or machines in healthcare settings and indicated that future nurses would be required to have a higher level of education when operating these devices (Table 4.24). Nearly a quarter (n=22, 20.37%) of respondents were *totally unwilling to neutral* in their responses and indicated that it would not be a requirement for nurses in the new healthcare era to be equipped with digital literacy skills, while also having diverse responses on the extent of their *readiness* to use digital devices in healthcare settings ($\bar{x}$ 4.22, SD 0.94).

Mahmoudi and Moradi (2024) confirm that nurses will require a higher level of education when operating AI in nursing care. Educating nurses about digital technology is very important so that they can capably operate digital devices and machines when rendering patient care (Brown, Pope, Maria et al., 2020). A study by Kleib et al. (2022) addresses the gaps and inconsistencies in nursing students' readiness to use digital technology in the new healthcare era. The findings of the mentioned study indicate that it should be a matter of urgency to guarantee that graduates are adequately ready to use digital technology upon joining the workplace.

Item 36: Nursing units that are making use of digital devices could require fewer nursing staff than in the past

In Item 36, just the majority (n=93, 86.11%) of 108 (100.00%) respondents indicated that they were *totally willing* to use digital devices that would require fewer nursing staff than currently (Table 4.24). Fifteen (n=15, 13.90%) of the respondents were *totally unwilling to neutral* in their responses to participate in nursing units that would make use of digital devices that would require fewer nurses than currently ($\bar{x}$ 4.47, SD 0.81).

A study by Katsaouni, Tripsianis, Constantinidis et al. (2024) on job insecurity in the workplace among nurses, indicates that nurses are accepting the idea that nursing

units will need less staff to deliver nursing care in the new healthcare of the 4IR due to the ongoing and speedy integration of digital technology into the healthcare settings.

Item 37: The movement towards robotic surgery will create an environment for assisting more patients in a shorter period

In Item 37, less than three-thirds (n=92, 85.19%) of 108 (100.00%) respondents indicated their *total willingness* in their responses that the movement towards robotic surgery will create an environment of assisting more patients in a shorter period (Table 4.24), compared to the sixteen (n=16, 14.81%) respondents who were *totally unwilling to neutral* and indicated that the traditional hands-on approach of surgery by humans, could not be replaced by robots ($\bar{x}$ 4.25, SD 0.86).

Lunardi, Abou-Zamzam, Florecki et al. (2024) conducted a study on robotic technology in emergency surgery. The findings of their study indicate that nursing staff agreed that robotic surgery versus laparoscopic surgery is more related to a decreased change to open surgery, resulting in a decreased postoperative length of stay in normally performed procedures.

Significant differences between the responses of students from the different genders were found in Item 25.

Table 4.25: The responses of students from different genders on the need for IT in healthcare to improve high-quality patient care (Item 25)

Gender responses of respondents: (n=106)														
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values	SD
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)	
Male	3	2.83	4	3.77	2	1.88	13	12.26	11	10.37	33	31.13	4.05	1.02
Female	0	0.00	3	2.83	12	11.32	26	24.52	32	30.18	73	68.87		

**Only 106 students from 108 (100.00%) responded on Item 25, as two students did not identify themselves as either male or female*

In Item 25, more than half (n=58, 79.45%) of 73 (100.00%) female respondents indicated their *totally willingness* that IT in healthcare settings was needed to improve high-quality patient care (Table 4.25). Less than one-tenth (n=9, 27.28%) of 33 (100.00%) male respondents were *totally unwilling to neutral* in their responses and indicated that high-quality patient care could not be accomplished using IT.

The responses obtained a high mean value of 4.05 with a normal distribution of the responses (SD 1.02) around the mean value, indicating that students to a larger extent, were *ready* to use Information Technology that could improve high-quality patient care (Table 4.25).

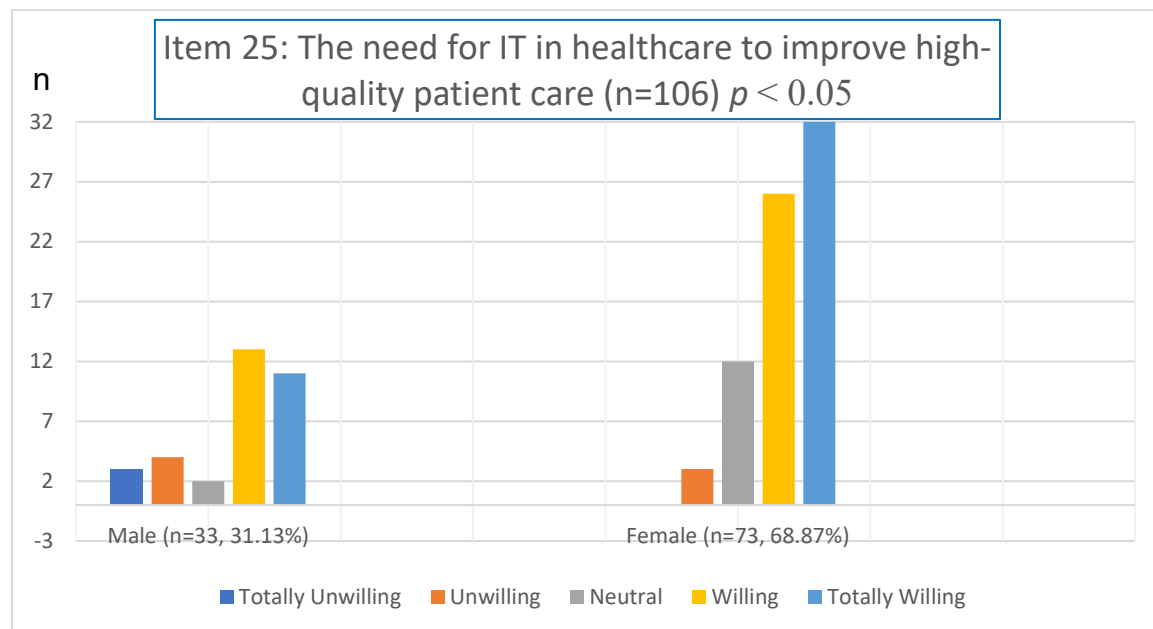


Figure 4.25: Distribution of significant differences between responses of students from different genders on the need for Information Technology in healthcare to improve high-quality patient care (Item 25)

The Likelihood Ratio Test refined the Pearson's Chi-Square Test (Table 4.26) and confirmed a significant difference between the gender responses on Item 25 (Item 25, Figure 4.25). More female respondents indicated their *willingness* to use Information Technology such as E-prescribing in healthcare for online consultation and medication orders, and electronic ordering of medical tests and procedures to improve high-quality patient care ($\chi^2 = (4, (N = 106), 11.878, p = .0183, p < 0.05)$). The null hypothesis was rejected.

The future of healthcare is characterised by speedy developments, increased patient needs and transformative technologies that are much needed for high-quality patient care in the new era of healthcare 4.0 (Li & Carayon, 2021).

Table 4.26: Significant differences between responses of students from different genders on the need for IT in healthcare to improve high-quality patient care (Item 25)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	11.405	4	0.0224	Yes
Likelihood Ratio	2-sided	11.878	4	0.0183	Yes

The implementation and digital transformation of IT into healthcare settings have brought progress to the accessibility of health services, particularly around the use of telemedicine and mobile health applications (Judijanto et al., 2024). The integration of smart developments such as AI and IT into healthcare settings holds huge possibilities to improve the quality of healthcare and patient outcomes. These inventions are not only improving the success and accessibility of healthcare but also making it more patient-centred (Ayers, Desai & Smith, 2024; Rettinger et al., 2024).

Significant differences between the responses of students from the different nursing programmes were found in Item 37.

Table 4.27: The responses of students from different nursing programmes on robotic surgery that creates an environment of assisting more patients in a shorter period (Item 37)

Responses of students from different nursing programmes: (n=108)														
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values	SD
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)	
BNURS	0	0.00	3	2.78	17	15.74	18	16.67	12	11.11	50	46.30	4.25	0.86
BTECH	6	5.55	8	7.41	16	14.81	15	13.89	13	12.04	58	53.70		

Less than a third (n=30, 60.00%) of 50 (100.00%) respondents in the Bachelor of Nursing programme, and a quarter (n=28, 48.27%) of 58 (100.00%) respondents in the Baccalaureus of Technology in Nursing programme, were *totally willing* to make use of robotic surgery that could create an environment of assisting more patients in a shorter period (Table 4.27). Less than half (n=50, 46.30%) of respondents in both nursing programmes were *totally unwilling to neutral* in their responses, and indicated their *unwillingness* to participate in robotic surgery that could assist more patients than currently (Item 37).

The respondents obtained a high mean value of 4.25 with a normal distribution of the responses (SD 0.86) around the mean value, indicating more positive responses from

students regarding the extent of their *readiness* to be part of robotic surgery that could assist more patients than currently (Table 4.27).

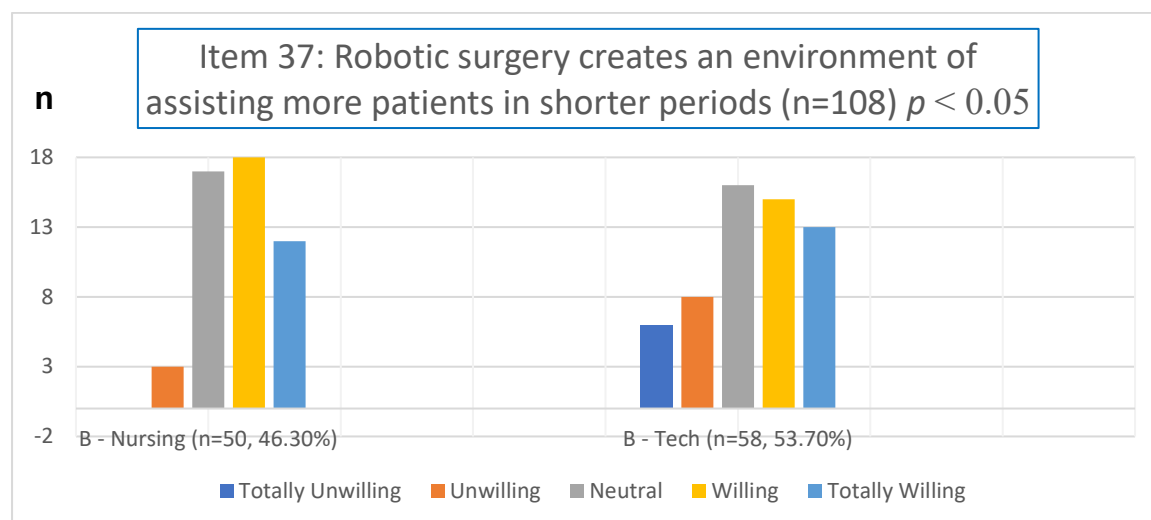


Figure 4.26: Distribution of significant differences between responses of students in the different nursing programmes on robotic surgery that creates an environment of assisting more patients in a shorter period (Item 37)

The Likelihood Ratio Test (Table 4.28) indicated a significant difference between the different nursing programme responses (Item 37, Figure 4.26), indicating that more respondents in the Baccalaureus of Technology in Nursing programme, were more *unwilling* to participate in the movement towards robotic surgery that could create an environment of assisting more patients in a shorter period ($\chi^2 = (4, (N = 108), 10.426, p = .0338, p < 0.05)$). The null hypothesis was rejected.

Table 4.28: Significant differences between responses of students from different nursing programmes on robotic surgery that creates an environment of assisting more patients in a shorter period (Item 37)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	8.067	4	0.0891	No
Likelihood Ratio	2-sided	10.426	4	0.0338	Yes

Robotic surgery has transformed the new era of healthcare and modern medicine by providing improved skills and visualisation compared to traditional methods (Reddy, Gharde, Tayade et al., 2023; Mohammadnejad et al., 2023). AI applications in robotic surgery focus on programming tasks like suturing to improve the consistency and decrease the workload of surgeons. Advantages of AI integration such as robotic

surgery, include improved accuracy, reducing surgeon fatigue, helping patients in shorter periods and improving their safety (Iftikhar, Saqib, Zareen et al., 2024; Hariyati, Handiyani, Zaharany et al., 2024).

Significant differences between the responses of students from the different nursing programmes were found in Item 37.

Table 4.29: The responses of students from different nursing programmes on robotic surgery that creates an environment of assisting more patients in a shorter time period (Item 37)

Responses of students in the different nursing programmes: (n=108)													
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)
3 rd	0	0.00	3	2.77	17	15.74	18	16.66	12	11.11	50	46.30	3.55
4 th	6	5.55	8	7.40	16	14.81	15	13.88	13	12.03	58	53.70	
													1.12

More than one-quarter (n=30, 60.00%) of 50 (100.00%) respondents in 3rd-year, and (n=28, 48.27%) of 58 (100.00%) in 4th-year, were *totally willing* to participate in robotic surgery that could create an environment of assisting more patients in a shorter period (Table 4.29). Nearly half (n=50, 46.30%) of the respondents in both year levels were *totally unwilling to neutral* in their responses and indicated their *unwillingness* to participate in the use of robotic surgery in healthcare, to assist more patients over a shorter period.

The respondents obtained a normal mean value of 3.55 with a wide distribution of the responses (SD 1.12) around the mean value, which indicated a diverse distribution of responses from students on the extent of their *readiness* to use robotic surgery that could assist more patients over shorter periods (Table 4.29).

The Likelihood Ratio Test (Table 4.30) refined the Pearson's Chi-Square Test and confirmed a significant difference between the year-level responses in Item 37 (Figure 4.27), indicating that more respondents in the Bachelor of Nursing programme were *willing* to participate in the movement towards robotic surgery, that could create an environment of assisting more patients in a shorter period ($\chi^2 = (4, (N = 108), 10.426, p = .0338, p < 0.05)$). The null hypothesis was rejected.

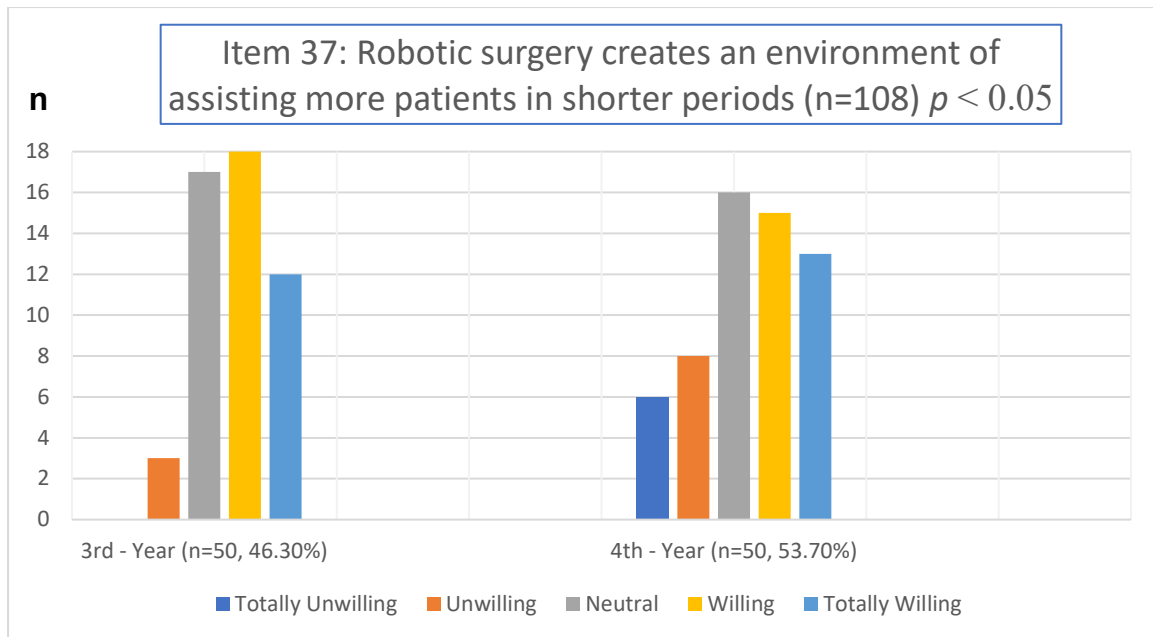


Figure 4.27: Distribution of significant differences between responses of students in different nursing programmes on robotic surgery that creates an environment of assisting more patients in shorter periods (Item 37)

Table 4.30: Significant differences between the responses of students in different nursing programmes on robotic surgery that creates an environment of assisting more patients in a shorter period (Item 37)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	8.067	4	0,0891	No
Likelihood Ratio	2-sided	10.426	4	0.0338	Yes

Worldwide, the modern hospital setting in the new era of healthcare is attentively connected to engineering and technology (Yadav, 2024). Modern digital equipment is abundant in every nursing department including the operating room. Thus, the quality of treatment offered in hospitals and technology developments are closely linked (Iacob, Iacob, Ghenciu et al., 2024). Robotic surgery is used to support and improve the accuracy and speed of human surgeons during medical procedures (Handa, Gaidhane & Choudhari, 2024). This surgical approach is commonly referred to as robotic surgery or robotic-assisted surgery (RAS).

4.3.4 Factor 3: Staff insecurity of their future role in a changing nurse-patient environment

4.3.4.1 Factor description

Factor 3 indicated the staff insecurity of nursing students regarding their future role in a changing nurse-patient environment (Table 4.31). The overall Cronbach's Alpha (α) of Factor 3 was 0.838651. Factor 3 addressed: (i) *psychological awareness*, (ii) *social and interpersonal relationships*, and (iii) *knowledge*.

According to Hallaran et al. (2023) and Rudberg, Westerbotn, Sormunen et al. (2022), one of the important phases in the nursing students' professional development happens during training, when they gain knowledge and skills that distinct them as professional healthcare workers from the masses. Job insecurity happens when students lack knowledge and competence (two important attributes) that are needed to deliver high-quality nursing care in the forthcoming industries of healthcare (Rodríguez-Pérez, Mena-Navarro, Domínguez-Pichardo et al., 2022).

Nurses are an important workforce in the global health system, and as such, providing the best working conditions is important for maintaining their well-being and good performance (Almeida, Figueiredo & Lucas, 2024; Mabona, van Rooyen, Ten Ham-Baloyi, 2022). According to Prado-Gascó, Giménez-Espert and De Witte (2021), among the psychosocial risks that seem to adversely affect healthcare workers, job insecurity has the most effect on workers and people in general (Lübke, 2021).

Table 4.31: Factor 3: Staff insecurity of their future role in a changing nurse-patient environment

Dimensions in Factor 3	Items	Cronbach's Alpha (α) per item
• Psychological awareness	6	0.8466
• Social and interpersonal relationships	20	0.8186
	21	0.8267
	22	0.8171
• Knowledge	30	0.8056
	31	0.8264
	32	0.8238
	33	0.8281
	39	0.8201

(i) Psychological awareness

Digital technology will have a huge impact on the nursing profession in the new era of healthcare (Isidori et al., 2022; Krick et al., 2019). As healthcare technology advances, hospitals become flooded daily by the great numbers of patients they see. According to Al Ahmari et al. (2023), nurses will be able to help their patients more effectively and efficiently and therefore, increase their feeling of job satisfaction by using the latest developments in technology (Item 6).

(ii) Social and interpersonal relationships

Information technology helps add to patient-centered care by nurturing communication between healthcare providers and patients through online channels, text messaging, and email (Rothlisberger, 2024; Alexander, Ogle, Hoberg et al., 2021; Lee, Rawl, Dickinson et al., 2020). According to Thielmann, Hoving, Cals et al. (2023) and Monaghesh and Hajizadeh (2020), IT increases access to information such as online medical records, which can improve self-monitoring and patient suitability, allowing nurses more time to improve patient care (Item 20).

The transfer of private patient information between doctors can have a high-risk outcome for communication mistakes (Rowland & Adefuye, 2022; Kwame & Petrucka, 2021). Therefore, the use of electronic handover programs such as Zoom (Item 21) could improve the quality of inter-communication between staff members in healthcare settings and reduce the risk of communication errors (Dietl et al., 2023; Delardes, McLeod, Chakraborty et al., 2020).

According to Popescu, El-Chaarani, El-Abiad et al. (2022), there should be no uncertainty that health information technology is an important tool for improving healthcare quality and safety (Item 22) and is a requirement in healthcare as it also improves communication that will benefit patients (Teixeira et al., 2023).

(iii) Knowledge

Regular hospital visits can become very costly, especially for patients staying in rural areas due to travel costs (Kornelsen, Khowaja, Av-Gay et al., 2021). The outbreak of pandemics such as COVID-19 prevents physical contact between patients and nurses and makes it become a risky interaction (Moyo, Mavhandu-Mudzusi &

Haruzivishe, 2022; Monaghesh & Hajizadeh, 2020). Therefore, many people have participated in the use of telemedicine.

Telemedicine health services can reduce medical consultations through the process of e.g., video conferencing and other virtual technologies (David-Olawade, Olawade, Ojo et al., 2024; Thomas, Lee, McClelland et al., 2023). It saves both the patient and the healthcare worker not only time and the cost of the treatment (Item 30) but also makes it more suitable for patients to make use of medical online software programs to complete their medical history, which could allow more accurate diagnoses (Haleem et al., 2021a).

Cloud computing is one of the important enablers of health information developments in the healthcare sector (Javaid, Haleem, Singh, Rab, Suman & Khan, 2022). The worldwide switch of patient records in the healthcare sector through electronic media by the process of cloud computing allows the use of cloud storage for patient information to help improve accessibility, while reducing wastage (Item 31).

According to Canziani and MacSween (2021), artificial intelligence-driven voice technology installed on smart devices such as Siri (Apple's virtual assistant) has the potential to improve the management of patient care, and the monitoring of patients before admission is required (Item 32). Groundbreaking invention technologies such as three-dimensional (3D) printing are expected to replace traditional methods (Item 33) e.g., prosthetics or customised dental devices, to improve patient care (Rezaie, Farshbaf, Dahri et al., 2023).

Radiofrequency identification (RFID) is used by healthcare workers to routinely collect patient information and data (Profetto, Gherardelli & Iadanza, 2022). An RFID label is attached to a patient and collects data that can be read without any physical contact from nursing staff. RFID technology will improve patient care by giving information about the patient's vital signs (Item 39) with the use of radio waves while capturing the data automatically and in real-time without the involvement of nurses (Luschi, 2024). Once labeled, patients can be identified, traced, and managed through a central database by using general IT devices such as PDAs (Personal Digital Assistants) or mobile phones (Istepanian, 2022).

4.3.4.2 Factor 3: Findings on the insecurity of staff regarding their future

Factor 3 addressed the insecurity of staff regarding their future role in a changing nurse-patient environment; referring to (i) psychological awareness, (ii) social and interpersonal relationships, and (iii) knowledge, was addressed.

An overall view of the distribution of the mean values of the three dimensions in Factor 3 is outlined in Figure 4.28. The items on which respondents indicated a more negative response towards *readiness* were in the dimension of social and interpersonal relationships (Item 21). In Item 21, 63 (58.33%) of 108 (100.00%) respondents were *totally unwilling to neutral* in their responses and indicated that inter-communication between staff members in healthcare settings cannot be done differently in the form of an electronic handover of patients via Zoom ($\bar{x}$ 3.25, SD 1.29).

The items in the dimension of *knowledge* of the students had the highest mean values ($\bar{x}$ 3.87 - 3.98) with a normal distribution of responses around the mean values (SD 0.99 - 1.09) in Factor 3.

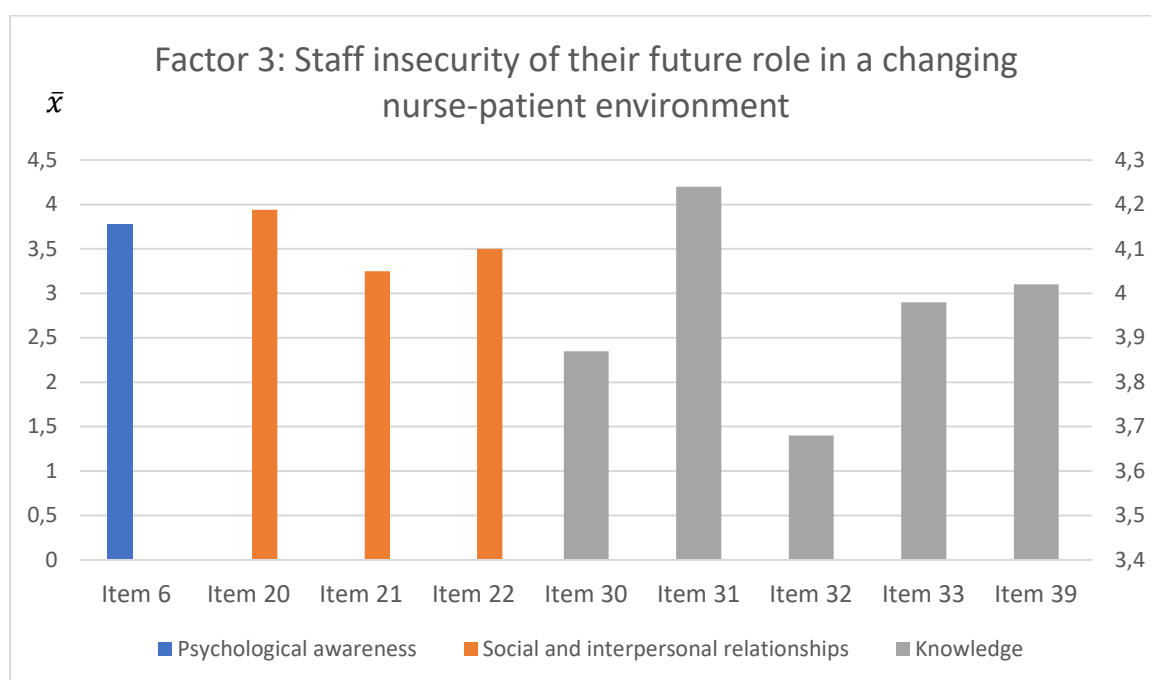


Figure 4.28: Mean values ($\bar{x}$) of items on staff insecurity of their future role in a changing nurse-patient environment (Factor 3)

Table 4.32: Descriptive statistics on Factor 3: Staff insecurity of their future role in a changing nurse-patient environment (n= 108)

Items	As a nursing student, I am willing (ready) to participate in the digital changes emerging in healthcare, because...	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		(x̄)	SD
		1		2		3		4		5					
		n	%	n	%	n	%	n	%	n	%	n	%		
	Psychological awareness														
6	the use of Information technology in healthcare increases nurse’s feeling of job satisfaction.	3	2.80	7	6.54	30	28.03	39	36.45	29	27.10	107	*100.92	3.77	1.00
Social and interpersonal relationships															
20	the use of Information Technology (IT) in healthcare, allows nurses more time to improve patient care.	2	1.85	8	7.41	23	21.30	36	33.33	39	36.11	108	100.00	3.94	1.02
21	inter-communication between staff members in healthcare settings, is done differently e.g., an electronic handover of patients by means of Zoom.	13	12.04	16	14.81	34	31.48	21	19.44	24	22.22	108	100.00	3.25	1.29
22	the use of Information Technology (IT) in healthcare improves communication, benefitting patients.	6	5.56	10	9.26	38	35.19	32	29.63	22	20.37	108	100.00	3.50	1.08
Knowledge															
30	patients will be able to make use of medical online software to complete their medical history, that could facilitate more accurate diagnoses.	3	2.78	9	8.33	27	25.00	28	25.93	41	37.96	108	100.00	3.87	1.09
31	the use of cloud storage for patient information helps to improve accessibility while reducing wastage.	2	1.85	7	6.48	11	10.19	31	28.70	57	52.78	108	100.00	4.24	1.00
32	the use of digital virtual assistants such as Siri (Apple’s virtual assistant), will monitor the patients before admission is needed.	4	3.78	9	8.50	31	29.24	33	31.13	29	27.36	106	*100.01	3.68	1.08
33	the use of 3D printing is used to create e.g., prosthetics, or customised dental devices to improve patient care.	3	2.78	4	3.70	24	22.22	38	35.19	39	36.11	108	100.00	3.98	0.99
39	Radio-frequency identification (RFID) technology will improve patient care by providing information about the patient’s vital signs.	1	0.93	1	0.93	29	26.85	40	37.04	37	34.26	108	100.0	4.02	0.85

Due to statistical calculations do not add to 100.00%

Factor 3: Psychological awareness of staff insecurity about their future role in a changing nurse-patient environment (Item 6)

With the descriptive statistics regarding the dimension of psychological awareness in Factor 3, the only mean value was obtained on Item 6 on how the use of Information technology in healthcare will increase the feeling of job satisfaction among nurses ($\bar{x}$ 3.77, SD 1.00).

Item 6: The use of IT in healthcare increases nurses' feelings of job satisfaction

In Item 6, less than two-thirds (n=68, 62.96%) of 108 (100.00%) respondents were *totally willing* to use IT in healthcare, which could increase job satisfaction among nursing staff in hospitals (Table 4.32). Just over a third (n=40, 37.04%) of 108 (100.00%) respondents were *totally unwilling to neutral* to use IT that could increase job satisfaction in their workplace. According to Pressley and Garside (2023), nurses form the biggest group of healthcare workers and require value-added job satisfaction and retention. Digitalisation in healthcare settings has intensely reformed work tactics and changed nurses' attitudes toward their job, resulting in an increased feeling of job satisfaction (Shao, 2024). *Significant differences* between the responses of students on their marital status of respondents were found in Item 6.

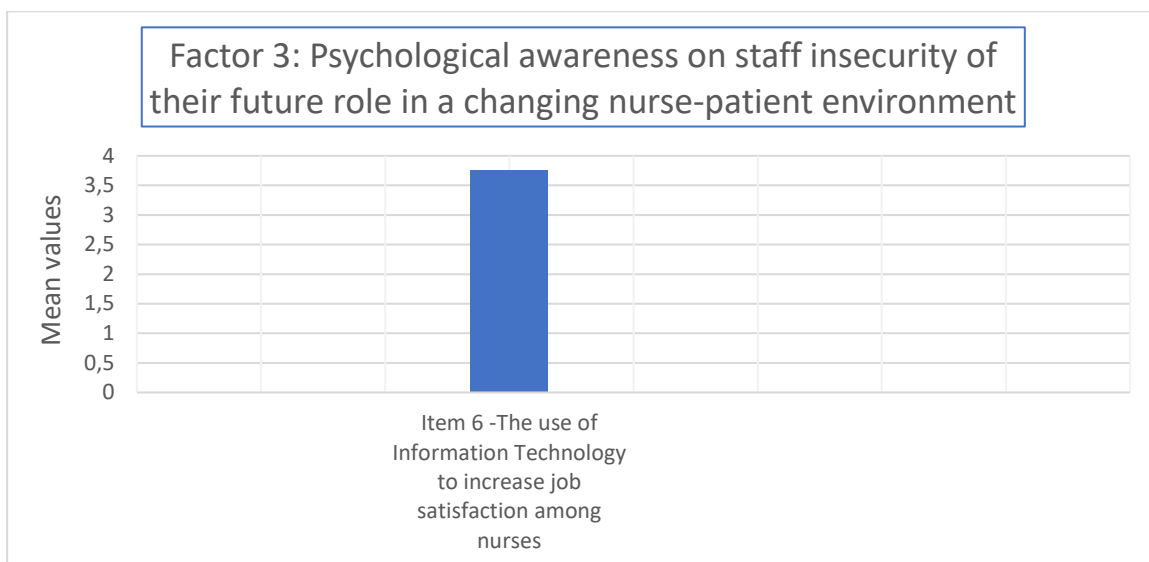


Figure 4.29: Mean values ($\bar{x}$) in the dimension of psychological awareness of staff insecurity of their future role in a changing nurse-patient environment (Item 6)

Table 4.33: The marital responses of students on nurses using IT in healthcare to increase their feeling of job satisfaction (Item 6)

Responses of students regarding marital status: (n=107)														
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean value	SD
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)	
Married	1	0.93	0	0.00	0	0.00	2	1.86	5	4.67	8	7.47	3.77	1.00
Single	2	1.86	7	6.54	30	28.03	36	33.64	24	22.42	99	92.52		

Just more than half (n=60, 60.61%) of 99 (100.00%) single respondents, indicated their *total willingness* to use IT in healthcare that could increase nurses' feelings of job satisfaction (Item 6), as opposed to only 7 (n=7, 87.50%) of 8 (100.00%) married respondents, who indicated their *total unwillingness* to *neutral* responses to use IT for increased job satisfaction (Table 4.33). However, just over a third (n=39, 39.40%) of 99 (100.00%) single respondents were *totally unwilling to neutral*, opposed to only one (12.50%) of 8 (100.00%) married respondents, who indicated that healthcare technology could increase job satisfaction among nurses.

The respondents obtained a normal mean value of 3.77 with a normal distribution of the responses (SD 1.00) around the mean value on the students' extent of *readiness* to use Information Technology to increase a feeling of job satisfaction (Table 4.33).

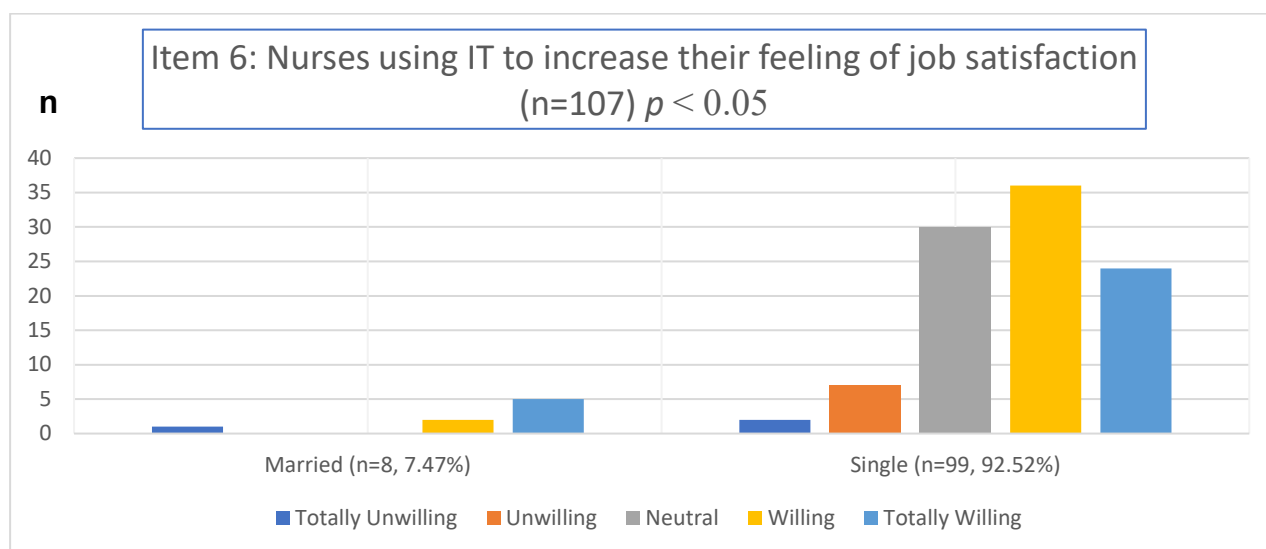


Figure 4.30: Distribution of significant differences between marital responses of students on nurses using IT in healthcare to increase their feeling of job satisfaction (Item 6)

The Likelihood Ratio Test (Table 4.34) refined the Pearson's Chi-Square Test and confirmed a significant difference between the responses of married versus single respondents in Item 6 (Figure 4.30) that the single respondents were more *willing* as opposed to the married respondents, to use IT in healthcare settings that could increase nurse's feeling of job satisfaction in their workplace ($\chi^2 = (4, (N = 107), 10.729, p = .0298, p < 0.05)$). The null hypothesis was rejected.

Table 4.34: Significant differences between the marital responses of students on nurses using Information Technology in healthcare to increase their feeling of job satisfaction responses (Item 6)

		Chi-Square		Prob	Reject H0
	Type	Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	10.156	4	0.0379	Yes
Likelihood Ratio	2-sided	10.729	4	0.0298	Yes

The advancement of groundbreaking healthcare technology is repeatedly required by healthcare workers including nurses in the healthcare sector (Arefin, 2024). Nurses need to adapt to the inclusion of digital technology in their workplace and are required to use different technological inventions such as EHRs (Dykes & Chu, 2021). However, the demand for quality care in providing patient safety using technology is still an issue, thereby affecting the achievement of nurse job satisfaction (Arruum, Setyowati & Artono Koestoer, 2024).

Factor 3: Social and interpersonal relationships on staff insecurity of their future role in a changing nurse-patient environment (Items 20, 21, 22)

In the dimension of social and interpersonal relationships in Factor 3 (Items 20, 21 & 22), the highest *mean values* were obtained on Item 20 ($\bar{x}$ 3.94, SD 1.02) on the use of IT in healthcare that will allow nurses more time to improve patient care; Item 21 on inter-communication between staff members in healthcare settings that can be done differently, and Item 22 ($\bar{x}$ 3.50, SD 1.08) on the use of IT in healthcare, that could improve communication that will benefit patients. Both the SDs of Items 20, 21, and 22 were normally distributed around the mean values (Table 4.32).

Item 20: The use of IT in healthcare allows nurses more time to improve patient care

In Item 20, just over two-thirds (n=75, 69.44%) of 108 (100.00%) respondents indicated their *total willingness* to use IT in healthcare settings that will allow nurses more time to improve patient care (Table 4.32). This statement is confirmed in a study by Rony, Parvin and Ferdousi (2024b), indicating that the integration and use of IT in advanced nursing practice will prepare nurses for future practice in the forthcoming industries in healthcare. IT has the potential to simplify patient care and reduce the nursing workload (Galiano, Moreno Fergusson, Guerrero et al., 2024). This allows nurses to focus more on direct patient care and to ensure the appropriate and organised delivery of healthcare services. Less than a third (n=33, 30.55%) of the respondents were *totally unwilling to neutral* in their responses, indicating that they were not *ready* to use IT in healthcare settings that would allow them more time to improve patient care ($\bar{x}$ 3.94, SD 1.02).

Item 21: Inter-communication between staff members in healthcare settings will be done differently, e.g., an electronic handover of patients by means of Zoom

In Item 21, less than half (n=45, 41.67%) of 108 (100.00%) respondents indicated their *total willingness* to use inter-communication between staff members in healthcare settings differently, e.g., an electronic handover of patients using Zoom (Table 4.32). Less than two-thirds (n=63, 58.33%) of the responses were *totally unwilling to neutral*, with a wide distribution around the mean value, on inter-communication between healthcare workers using electronic handover programs such as Zoom ($\bar{x}$ 3.25, SD 1.29). Students differed in the extent of being ready to use inter-communication methods in the handover of patients.

Item 22: The use of Information Technology in healthcare improves communication that benefits patients

In Item 22, half (n=54, 50.00%) of 108 (100.00%) respondents indicated that they were *totally willing* to use IT in healthcare settings to improve communication that will benefit patients (Table 4.32). Just over a third (n=38, 35.18%) of respondents were *neutral*, and a few (n=16, 14.82%) were *unwilling* to use IT in healthcare settings to improve communication with patients ($\bar{x}$ 3.50, SD 1.08). According to studies by Okolo,

Babawarun, Arowoogun et al. (2024), Okolo, Ijeh, Arowoogun et al. (2024), and Raman and Sullivan (2024), mobile health applications play an important role in promoting patient engagement by offering patients tools and resources to manage their well-being, and to make informed decisions about their health and treatment options. *Significant differences* between the responses of students from the different nursing programmes were found in Item 22.

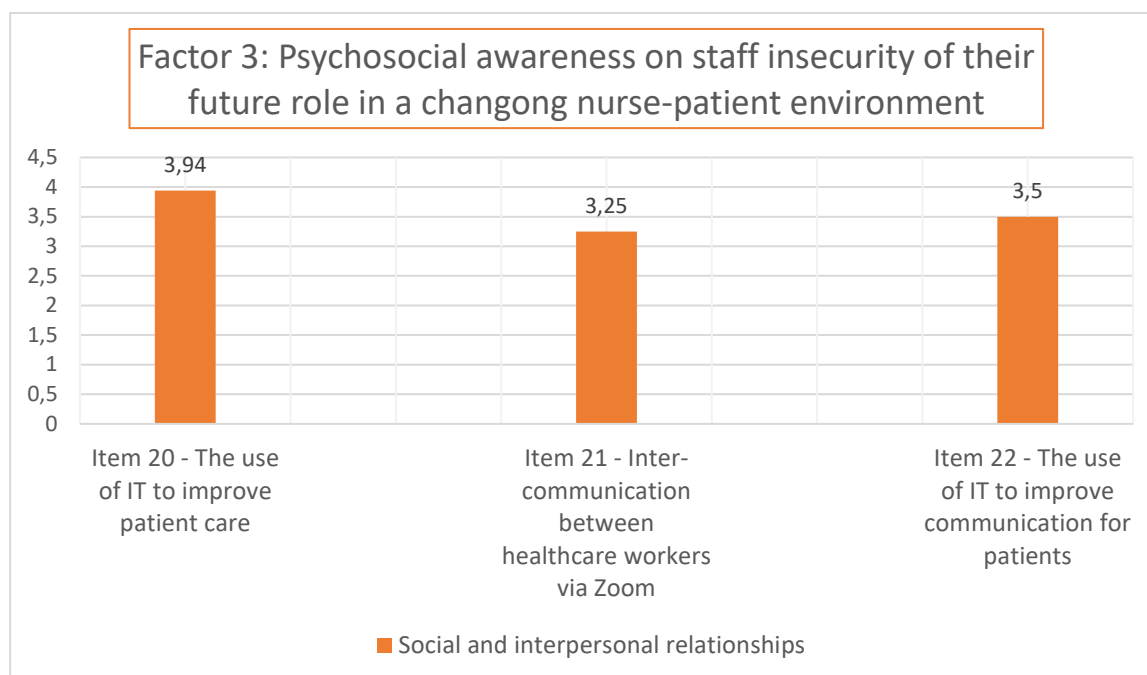


Figure 4.31: Mean values ($\bar{x}$) in the dimension of social and interpersonal relationships on staff insecurity of their future role in a changing nurse-patient environment (Items 20, 21, 22)

Table 4.35: The responses of students from the different nursing programmes on the use of IT in healthcare to improve communication that will benefit patients (Item 22)

Responses of students from the different nursing programmes: (n=108)														
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values ($\bar{x}$)	SD
	n	%	n	%	n	%	n	%	n	%	n	%		
BNURS	0	0.00	7	6.48	17	15.74	18	16.66	8	7.40	50	46.30	3.50	1.08
BTECH	6	5.55	3	2.77	21	19.44	14	12.96	14	12.96	58	53.70		

Just over a quarter (n=28, 48.27%) of 58 (100.00%) respondents in the Baccalaureus of Technology in Nursing programme, indicated their *total willingness* to use IT in healthcare such as telemedicine to improve communication that will benefit patients (Table 4.35) versus the 24 (48.00%) of 50 (100.00%) respondents in the Bachelor of Nursing programme, who was *totally unwilling to neutral* in their responses to use IT such as telemedicine in healthcare settings that could improve communication to benefit patients (Item 22).

The responses obtained a mean value of 3.50 with a normal distribution of the responses (SD 1.08) around the mean value on their responses regarding the extent of their *readiness* to use IT to improve communication between patients and healthcare workers (Table 4.35).

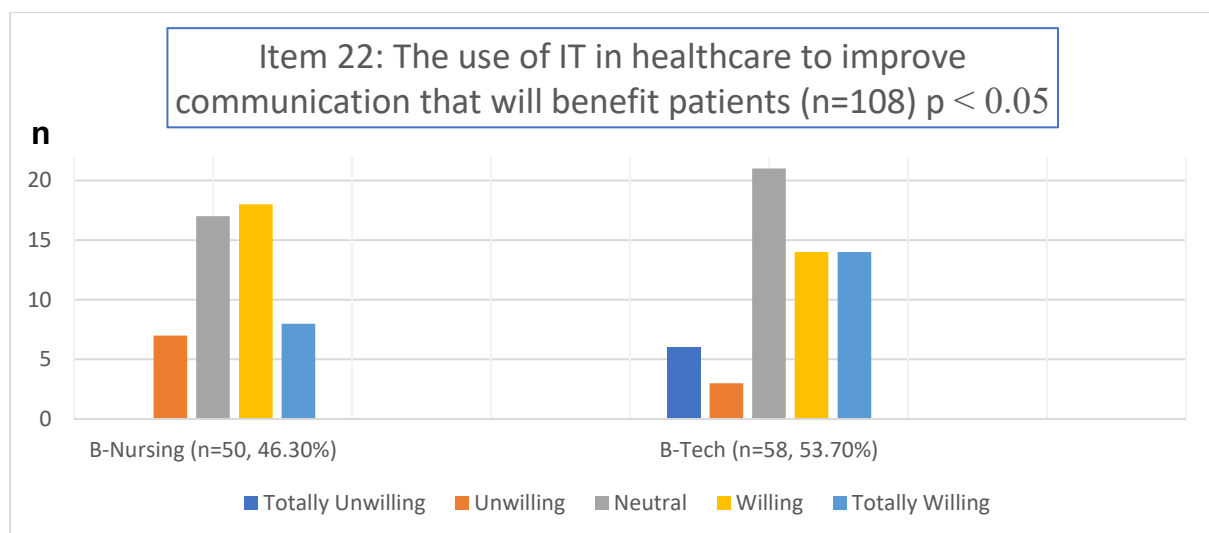


Figure 4.32: Distribution of significant responses between students in the different nursing programmes on using IT in healthcare to improve communication that will benefit patients (Item 22)

The Likelihood Ratio Test refined the Pearson's Chi-Square Test (Table 4.36) and confirmed a significant difference between the respondents from the two different nursing programmes in Item 22 (Figure 4.32), and indicated that more of the respondents in the Baccalaureus of Technology in the Nursing programme was *willing* to use IT in healthcare settings, that could improve communication that will benefit patients ($\chi^2 = (4, (N = 108), 11.951, p = .0177, p < 0.05)$). The null hypothesis was rejected.

Table 4.36: Significant differences between responses of students in the different nursing programmes on the use of IT in healthcare to improve communication that will benefit patients (Item 22)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	9.618	4	0.0474	Yes
Likelihood Ratio	2-sided	11.951	4	0.0177	Yes

The daily flow in using IT can lead to the need for healthcare workers to combine technology skills into practice (Mohammadnejad et al., 2023). The transformative role of technology in reshuffling the administrative practices in healthcare not only improves communication between nurses and patients but also improves general patient care (Sarella & Mangam, 2024). Advances in IT have created new opportunities for the healthcare sector, such as improving patient appointments, treatment choices, and the quality of patient care (Capriulo, Pizzolla & Briganti, 2024). *Significant differences between* responses in the different nursing programmes were found in Item 22.

Table 4.37: The responses of the students in the different nursing programmes on the use of IT in healthcare to improve communication that will benefit patients (Item 22)

Responses of students in the different nursing programmes: (n=108)													
Year level	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values ($\bar{x}$)
	n	%	n	%	n	%	n	%	n	%	n	%	
3 rd	0	0.00	7	6.48	17	15.74	18	16.66	8	7.40	50	46.30	3.50
4 th	6	5.55	3	2.77	21	19.44	14	12.96	14	12.96	58	53.70	

Less than a quarter (n=26, 52.00%) of 50 (100.00%) junior respondents in 3rd year, and just over a quarter (n=28, 48.28%) of senior respondents in 4th year, were *totally willing* to use IT in healthcare to improve communication between healthcare workers and patients, that could benefit patient care (Table 4.37). Less than a quarter (n=24, 48.00%) of 50 (100.00%) respondents in the 3rd year, and more than half (n=30, 51.72%) of 58 (100.00%) respondents in the 4th year, were *totally unwilling to neutral* in their responses, and indicated their *unwillingness* to use IT in the workplace to improve patient communication.

The respondents obtained a low mean value of 3.50, with a normal distribution of the responses (SD 1.08) around the mean value for the extent of their *readiness* to use IT to improve communication between patients and healthcare workers (Table 4.37).

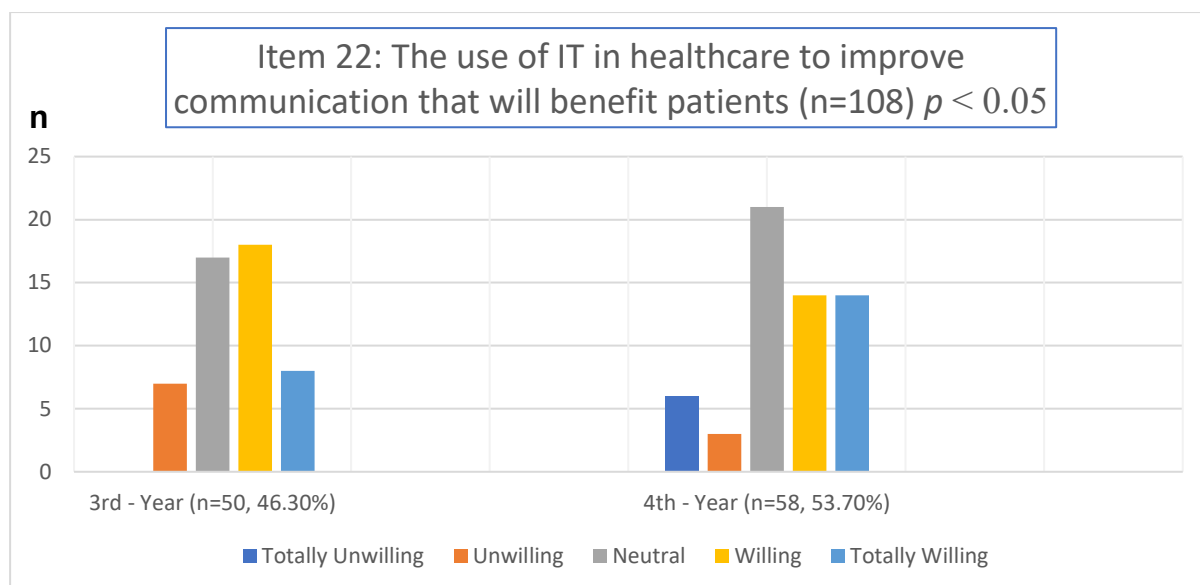


Figure 4.33: Distribution of significant differences between students in the different nursing programmes on the use of IT in healthcare to improve communication that will benefit patients (Item 22)

The Likelihood Ratio Test (Table 4.38) refined the Pearson's Chi-Square Test and confirmed a significant difference between the year-level responses on Item 22 (Figure 4.33), indicating that respondents in both year levels were *willing* to use IT to improve communication between patients and healthcare providers that will benefit patients ($\chi^2 = (4, (N = 108), 11.951, p = .0177, p < 0.05)$). The null hypothesis was rejected.

Table 4.38: Significant differences between responses of students in the different nursing programmes on the use of Information Technology (IT) in healthcare to improve communication that will benefit patients (Item 22)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	9.618	4	0.0474	Yes
Likelihood Ratio	2-sided	11.951	4	0.0177	Yes

The integration of AI and IT in healthcare settings is a well-known method for developing ongoing, high-quality patient-care practices that are needed in the new era of healthcare (Sarella & Mangam, 2024). The effect of IT as a patient-supplier communication instrument, helps nurses to allow dialogue and to guarantee that no

important detail is lost in translation. Effective healthcare communication is important for achieving high-quality patient care and improving the health of patients (Sharkiya, 2023). Communication is the network through which patient-nurse trust is formed, vital medical information is issued, and patient care is delivered to benefit patient outcomes (Esmailzadeh, Dharanikota & Mirzaei, 2024).

Factor 3: Knowledge on staff insecurity of their future role in a changing nurse-patient environment (Items 30, 31, 32, 33, 39)

The dimension of *knowledge* in Factor 3 (Items 30, 31, 32, 33, 39) indicated that the highest mean value was obtained on Item 31 ($\bar{x}$ 4.24, SD 1.00) that the use of cloud storage for patient information will help to improve accessibility while reducing wastage.

Item 30: Patients will be able to make use of medical online software to complete their medical history, which could facilitate more accurate diagnoses

In Item 30, less than two-thirds (n=69, 63.89%) of 108 (100.00%) respondents indicated their *total willingness* in their responses and indicated that they would make use of medical online software where patients could participate to complete their medical history to facilitate more accurate diagnoses (Table 4.32). According to Verma, Buch, Pandya et al. (2024), assisted history-taking systems can be used in teleconsultations to task-shift the retrieval of a patient's medical history and to provide physical examination information to healthcare workers. Just over a third (n=39, 36.11%) of the respondents were *totally unwilling to neutral* in their responses and indicated that patients would not be able to complete their medical history online through online software programs ($\bar{x}$ 3.87, SD 1.09).

Item 31: The use of cloud storage for patient information helps to improve accessibility while reducing wastage

In Item 31 (Table 4.32), more than three-quarters (n=88, 81.48%) of 108 (100.00%) respondents indicated their *total willingness* to use cloud storage for patient information, which could help to improve the accessibility of patient information while reducing wastage ($\bar{x}$ 4.24, SD 1.00). Less than a quarter (n=20, 18.51%) of the

respondents were *totally unwilling to neutral* in their responses and indicated their *unwillingness* towards the use of cloud storage in this regard. However, with the progression of computer systems, patient records are gradually digitized into electronic records that include patient information regarding their past, current, or future physical or mental health, or overall medical condition (Badr, Abdul Kader & Shamayleh, 2024).

Item 32: The use of digital virtual assistants such as Siri (Apple's virtual assistant) will monitor the patients before admission is needed

In Item 32, less than two-thirds (n=69, 63.88%) of 108 (100.00%) respondents indicated their *total willingness* to use digital virtual assistants such as Siri (Apple's virtual assistant), to monitor the patients before admission is required (Table 4.32). More than one-third (n=45, 41.66%) of the respondents were *totally unwilling to neutral* in their responses to participate in a healthcare environment of virtual assistance such as Siri, that could monitor patients before hospital admission ($\bar{x}$ 3.68, SD 1.08). A study done by Anisha, Sen and Bain (2024) indicates that many patients are missing the ability to capably navigate traditional telehealth apps due to reduced health-related or computer literacy and incapacities such as visual impairment. However, conversational agents (Cas) such as Siri may help to overcome these restrictions and improve usability by offering a demonstration of the apps' contents in a language understood by all patients (Tudor Car, Dhinakaran, Kyaw et al., 2020).

Item 33: The use of 3D printing can be used to create e.g. prosthetics or customised dental devices to improve patient care

On the other hand, more than two-thirds (n=77, 71.29%) of 108 (100.00%) respondents were *totally willing* to use 3D printing to create prosthetics or customised dental devices to improve patient care (Item 33, Table 4.32). Less than a third (n=31, 28.70%) of the respondents were *totally unwilling to neutral* in their responses and indicated their *unwillingness* not to make use of 3D printing that could create prosthetics and dental implants to improve patient care ($\bar{x}$ 3.98, SD 0.99).

Plastic surgery and prosthetic devices improve the quality of life for patients with traumatic injuries and congenital deformities that are affecting their physical appearance and abilities (Zahid, Mavani, Awuah et al., 2024; Banskota, Bhusal, Bhattarai et al., 2024). 3D printing has meaningfully added benefits such as improved

design flexibility, decreased production time, and improved patient outcomes (Wang, Mu, Yan, Han, Ye & Guo, 2024).

Item 39: Radio-frequency identification (RFID) technology will improve patient care by providing information about the patient's vital signs

In Item 39, more than two-thirds (n=77, 71.30%) of the respondents indicated their *total willingness* to use RFID technology that could improve patient care (Table 4.32). However, more than a quarter (n=31, 28.70%) of the respondents indicated their *unwillingness* to use RFID technology in the workplace to improve patient outcomes ($\bar{x}$ 4.02, SD 0.85). In a study done by Escobedo, Pousibet-Garrido, López-Ruiz et al. (2024) findings indicate that in the field of wireless technology, RFID technology was used for sleep and vital signs monitoring and appeared to be an important tool that is used to monitor important parameters such as night-time behaviors, and vital signs of patients (Profetto et al., 2022).

The response indicated that most of the respondents were *ready* to make use of the assistance of digital technology to retrieve health records and information through online software such as virtual assistants (Siri), Cloud, and RFID technology. *Significant differences between the responses* of students from different genders were found in Item 32.

Table 4.39: The responses of students from different genders on the use of digital virtual assistants that will monitor the patients before admission was required (Item 32)

Responses of students from different genders: (n=106)														
	Totally unwilling		Unwilling		Neutral		Willing		Totally willing		Total		Mean values	SD
	n	%	n	%	n	%	n	%	n	%	n	%	($\bar{x}$)	
Male	0	0.00	6	5.66	12	11.32	11	10.37	4	3.77	33	31.13	3.68	1.08
Female	4	3.77	3	2.83	19	17.92	22	20.75	25	23.58	73	68.87		

*Only 106 students from 108 (100.00%) responded on Item 26, as two students did not identify themselves as either male or female

Less than two-quarters (n=47, 64.38%) of 73 (100.00%) female respondents, compared to less than a tenth (n=15, 45.45%) of 33 (100.00%) male respondents, indicated their *total willingness* to use virtual assistants such as Siri (Apple's virtual assistant) to monitor patients before any hospital admission was required (Table 4.39). Eighteen (n=18, 54.54%) of 33 (100.00%) male respondents versus a quarter (n=26,

35.62%) of the 73 female respondents, indicated in their responses that they were *totally unwilling to neutral* to use virtual assistants that could monitor a patient's medical condition such as hypertension, and detect abnormalities before admission to a healthcare setting was required. The responses indicated a normal mean value of 3.68 with a normal distribution of the responses (SD 1.08) around the mean value, for the extent to which students were *ready* to use virtual assistants such as Siri to monitor patients before any hospital admission was required (Table 4.39).

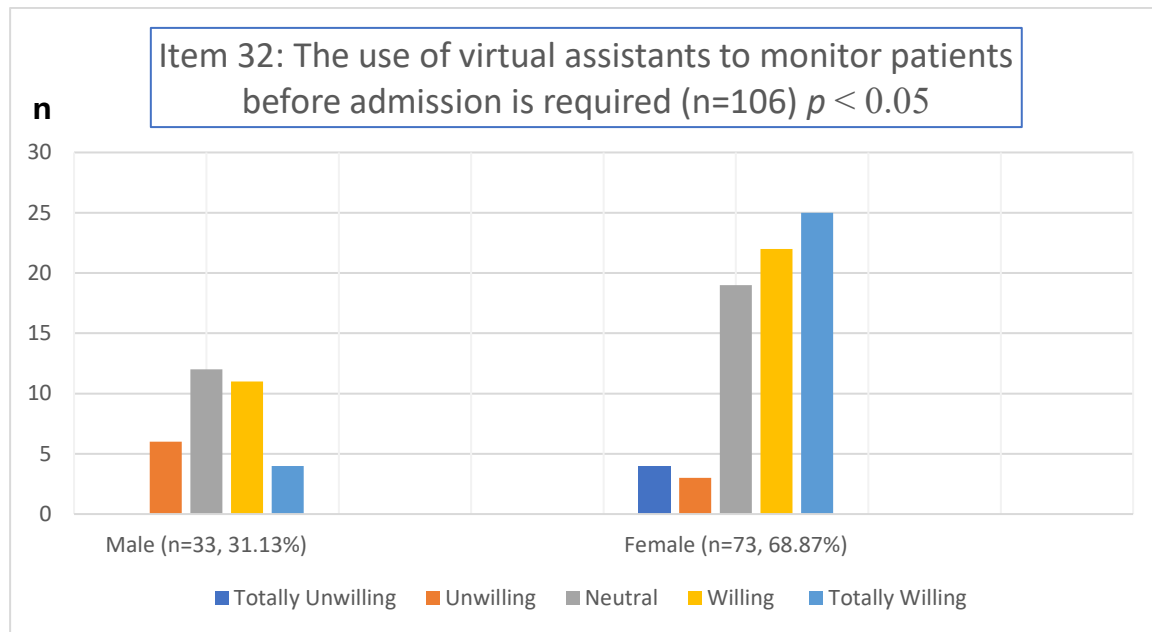


Figure 4.34: Distribution of significant responses between students from different genders on the use of virtual assistants to monitor patients before admission was required (Item 32)

The Likelihood Ratio Test (Table 4.40) refined the Pearson's Chi-Square Test and confirmed a significant difference between the gender responses on Item 32 (Figure 4.34), that female respondents were more *willing* than their male opponents to use virtual assistants such as Siri to monitor patients before any hospital admission was required ($\chi^2 = (4, (N = 108), 13.356, p = .0097, p < 0.05)$). The null hypothesis was rejected.

Table 4.40: Significant differences between responses of students from the different genders on the use of digital virtual assistants that will monitor the patients before admission was required (Item 32)

	Type	Chi-Square		Prob	Reject H0
		Value	DF	Level	at $\alpha = 0.05$?
Pearson's Chi-Square	2-sided	12.08	4	0.0168	Yes
Likelihood Ratio	2-sided	13.356	4	0.0097	Yes

The existence of digitalisation and AI has a huge impact on society, especially in the field of nursing (Maleki Varnosfaderani & Forouzanfar, 2024; Pailaha, 2023). Healthcare has undergone important changes due to the vast number of patients with chronic medical conditions (Chimezie, 2023). Digital health has become a reality with a rising number of people using chatbots and virtual assistants such as Siri for prognostic or diagnostic reasons, therapeutic planning, and monitoring of vital signs before any hospital admission is required (Mulure, Hewadmal & Khan, 2024; Krishnan, Singh, Pathania et al., 2023). Chatbots and virtual assistants have shown significant advantages in the medical field e.g., self-monitoring where patients are taking on a more empowered role, and becoming active participants in their care (Goumas, Dardavesis, Syrigos et al., 2024; Warren, Claman, Meyer et al., 2024; Larbi, Denecke & Gabarron, 2022).

The responses on the aspect of staff insecurity in future roles as Professional Nurses due to the use of technology in healthcare indicated that most of the respondents were positive that their current roles would not be endangered or replaced by digital technology in the healthcare setting. Instead, the respondents indicated that as Professional Nurses in the new healthcare era of the forthcoming industries, technology would allow them to spend more time with their patients and therefore, improve patient care and healthcare outcomes.

In Chapter 4 the focus was on analysing and displaying the study data with graphs, figures, and tables. The data that were analysed after the study was conducted, was interpreted and discussed concerning previous research.

Chapter 5 presents the conclusions that were drawn from the analyses by making relevant recommendations for any future studies. It pointed out some limitations of the study for supporting nursing students to be ready for their role as Professional Nurses in an environment of digital technology in hospitals in Cape Town. This chapter also concludes with the study.

CHAPTER 5

CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

5.1 INTRODUCTION

Chapter 5 concludes the entire research study by reassessing the research objectives as identified in Chapter 1 followed by the conclusion, the recommendations for future research on the research topic, and the limitations of the study.

The study aimed to investigate the extent to which senior students were ready to participate in a nursing environment of digital technology in hospitals in Cape Town. Objective 2 was to describe the support that can be given to nursing students to be ready for a nursing environment of digital technology in hospitals in Cape Town.

5.2 CONCLUSIONS

5.2.1 Demographics

Section 1 of the self-administered questionnaire focused on the demographics of the respondents. The findings in section 1 concluded that from the total of study respondents (n=108, 100.00%), more than two-thirds (n=73, 67.59%) were females, and just over a quarter (n=33, 30.56%) were males. Only 2 (n=2, 1.85%) of the respondents classified themselves as neither male nor female. The generational age distribution of the study respondents ranged between 20 to 52 years, representing Generations X and Y cohorts. Just over two quarters (n=98, 80.75%) of the total respondents were younger than 32 years of age and could be categorised as young adults from the Millennials (Generation Y) that were born between 1981 and 1996.

Less than two-thirds (n=65, 60.19%) of the 108 (100.00%) respondents spoke isiXhosa as their home language, while the second largest group of respondents, just thirteen (n=13, 12.04%), spoke Afrikaans as their home language. The languages that were predominantly spoken by most of the respondents were isiXhosa (n=65, 60.19%), followed by Afrikaans (n=13, 12.04%), and isiZulu (n=8, 7.41%).

Less than half of the respondents (n=50, 46.30%) were students in their 3rd year of the Bachelor of Nursing (R.174 of 8 March 2013) programme, versus just over half (n=58, 53.70%) of students in their 4th year of the Baccalaureus of Technology in

Nursing (R.425 of 22 February 1985 as amended) nursing programme. Although there was a difference in the year level and names of the programmes, both groups were registered at the South African Nursing Council in a 4-year nursing training programme that would allow them to after their nurse training, receive the qualifications as a Professional Nurse and Midwife. Less than half of the respondents (n=43, 39.81%) indicated that they had no daily access to the usage of a computer but were rather frequent computer users at the academic training institution or had insufficient data for internet access.

5.2.2 Readiness of respondents

The overall null hypothesis was:

H₀: There is no relationship between the responses of the 3rd and 4th-year students and their readiness (willingness) to participate in a nursing environment of digital technology in hospitals.

The null hypothesis was rejected in many of the items due to significant differences between the responses of the 3rd and 4th-year nursing student groups on their readiness (willingness) to participate in digital technology in hospitals.

5.2.2.1 Psychological awareness (Items 1-7)

The descriptive statistics regarding the dimension of psychological awareness in Factor 2 indicated that the highest mean values were obtained in Item 8 ($\bar{x}$ 4.10, SD 1.04) on nurses who can employ new technologies in their daily work life, such as the use of electronic duty rosters, and in Item 9 ($\bar{x}$ 4.22, SD 0.81) on different skills that would be required to operate digital devices in the workplace.

Seventeen (n=17, 15.74%) of the respondents indicated their *unwillingness* to use different skills that should be obtained to operate digital devices in their workplaces ($\bar{x}$ 4.22, SD 0.81) (Item 9).

Less than a quarter (n=25, 23.14%) of the respondents indicated their *unwillingness* to use electronic duty rosters as part of their daily work activities that would allow them to focus more on nurse-patient interaction ($\bar{x}$ 4.10, SD 1.04) (Item 15). On the other hand, over a quarter (n=30, 27.78%) of the respondents indicated their *unwillingness*

in their responses to use digital devices in the workplace that could transform traditional treatment options using digital intelligence ($\bar{x}$ 3.90, SD 0.94) (Item 2).

Just over a third (n=37, 34.25%) and 45 (41.66%) of 108 (100.00%) respondents were *totally willing* to make use of digital technologies such as robots that would require less physical involvement with patients, and to use new technologies such as robots that could provide nursing duties and participate more actively in the workplace (Item 11).

In Item 1, around half (n=57, 52.77%) of 108 (100.00%) respondents indicated their *willingness* to use digital devices that would become the driving force behind how individuals or groups think about the nursing profession ($\bar{x}$ 3.60, SD 0.85) (Item 1) however, respondents (n=51, 47.22%) indicated their *unwillingness* to use digital devices in the workplace ($\bar{x}$ 3.60, SD 0.85).

Less than two-thirds (n=63, 58.32%) of the respondents indicated their *unwillingness* in their responses to use robots in their workplace that could render nursing duties such as the distribution of meals to patients ($\bar{x}$ 3.19, SD 1.34) (Item 11). On the other hand, just over two-thirds (n=71, 65.73%) of the respondents indicated their *unwillingness* to use robots that would replace nursing duties such as the lifting of patients ($\bar{x}$ 3.08, SD 1.08).

Nearly three-quarters (n=78, 72.22%) of 108 (100.00%) respondents (Item 2) indicated their *willingness* to participate in the digitalisation of the nursing sector and to use digital devices that could transform the traditional methods of treatment through digital intelligence ($\bar{x}$ 3.90, SD 0.94). The majority of 83 (76.85%) and 91(84.26%) of 108 (100.00%) respondents (item 8) indicated their *willingness* to use new technologies such as electronic duty rosters in their daily work schedule and to acquire different skills to use digital devices in their workplace (Item 9).

5.2.2.2 Skills development (Items 8-18)

The descriptive statistics regarding the dimension of skills development in Factor 1 indicated that the highest mean values were obtained on Item 10 ($\bar{x}$ 4.56, SD 0.76) on the use of mobile application technology such as smartphones that will give nurses speedy access to patient information, and Item 18 ($\bar{x}$ 4.56, SD 0.77) on nurses who can use their cell phones to search for information about a patient's diagnosis.

Twelve (n=12, 11.11%) of 108 (100.00%) respondents indicated being *totally unwilling to neutral* to access a basic computer Windows program such as Microsoft Word to prepare for a patient presentation to their peers (Item 14). Eleven (n=11, 10.19%) of the respondents indicated their *unwillingness* in their responses and thus indicated *not being ready* to use their mobile phones to access patient information ($\bar{x}$ 4.56, SD 0.76) (Item 10).

Less than a fifth (n=20, 18.52%) of the respondents indicated their *unwillingness* towards the use of digital devices that could replace nursing duties ($\bar{x}$ 4.20, SD 0.87). In Item 18, only seven (n=7, 6.60%) of 106 (100.00%) respondents indicated their *unwillingness* to use their cell phones to search for information about a patient's diagnosis. *Significant differences between the gender responses* were found in the use of cell phones to search for information about a patient's diagnosis and to explore suitable treatment options.

In Item 15, only seven (n=7, 6.60%) of 106 (100.00%) respondents indicated their *unwillingness* in their responses to use electronic health records to improve patient care, as opposed to the vast majority (n=99, 93.39%) of respondents who were *totally willing* to use electronic health records to improve patient care. Less than a fifth (n=20, 18.51%) of the respondents in 3rd year indicated their *willingness* versus a third (n=39, 36.11%) of 4th-year respondents who were *willing* to use electronic health records to improve patient care and to ensure the accuracy of healthcare records ($\bar{x}$ 4.53, SD 0.71). *Significant differences between the responses* of the year levels were found in Item 15 on the use of electronic health records that would ensure accurate recordkeeping to improve patient care and outcomes.

In Item 10, just over two-thirds (n=75, 69.44%) of 108 (100.00%) senior respondents indicated their *willingness* to use mobile application technology such as smartphones to access patient information (Item 10).

More than three quarters (n=96, 88.89%) in Item 14 of the respondents indicated their *willingness* in their *responses* to use a software program such as PowerPoint to demonstrate a patient presentation to their colleagues ($\bar{x}$ 4.41, SD 0.85). A large majority (n=98, 90.74%) of 108 (100.00%) respondents indicated they were *totally willing* to access internet sources for patient information while working in a healthcare unit (Item 16, $\bar{x}$ 4.50, SD 0.75).

In Item 17, a large majority (n=88, 81.53%) of 108 (100.00%) respondents indicated their *willingness* to use more digital-orientated devices that could revise routine nursing tasks such as the checking of vital signs. The majority (n=99, 93.39%) of the respondents indicated their *willingness* in their responses to use their mobile devices to explore patient information and suitable treatment options. ($\bar{x}$ 4.56, SD 0.77).

5.2.2.3 Social and interpersonal relationships (Items 19-24)

The descriptive statistics regarding the dimension of social and interpersonal relationships in Factor 1 indicated that the highest mean value was obtained on Item 19 ($\bar{x}$ 4.10, SD 1.03) on how the quality of the relationship between healthcare workers and patients of different cultures, could improve through digital translation applications.

Just over a third (n=40, 37.04%) of the respondents indicated their *unwillingness* in their responses to use technology to improve the quality of the relationship between nurses and patients of different cultures ($\bar{x}$ 4.10, SD 1.03) (Item 19), and 39 (36.11%) of 108 (100.00%) respondents indicated their *unwillingness* to use technologies where patients could consult with doctors over long distances (Item 23).

Nearly two-thirds (n=69, 63.99%) of respondents indicated their *willingness* to make use of methods where patients could consult with doctors through technology applications ($\bar{x}$ 3.87, SD 1.11) (Item 23).

Nearly three-quarters (n=78, 72.22%) of 108 (100.00%) respondents indicated their *willingness* to use digital translation applications such as *Translators Café* to improve the quality of patient-nurse relationships (Item 19).

In the dimension of *social and interpersonal relationships in Factor 3* (Items 20, 21 & 22), the highest *mean values* were obtained in Item 20 ($\bar{x}$ 3.94, SD 1.02) on the use of Information Technology (IT) in healthcare that will allow nurses more time to improve patient care, Item 21 ($\bar{x}$ 3.25, SD 1.29) on inter-communication between staff members in healthcare settings that can be done differently, and Item 22 ($\bar{x}$ 3.50, SD 1.08) on the use of IT in healthcare that could improve communication that will benefit patients. *Significant differences between* the year level and different nursing programme responses were found in Item 22 on the use of IT in healthcare to improve communication that could benefit patients.

Less than a third (n=33, 30.55%) of the respondents were *totally unwilling to neutral* in their responses, indicating that they were not *ready* to use IT in healthcare settings that would allow them more time to improve patient care ($\bar{x}$ 3.94, SD 1.02).

Less than half (n=45, 41.66%) of 108 (100.00%) respondents indicated their *total willingness* to use inter-communication such as Zoom, between staff members in healthcare settings (Item 21). In Item 22, half (n=54, 50.00%) of 108 (100.00%) students responded that they were *totally willing* to use IT in healthcare settings to improve communication that will benefit patients, versus 54 (50.01%) of the respondents who were *totally unwilling to neutral* in their responses indicating their *unwillingness* to use IT in healthcare settings to improve communication with patients ($\bar{x}$ 3.50, SD 1.08) (Item 22).

Less than two-thirds (n=63, 58.33%) of the respondents indicated their unwillingness to use inter-communication methods such as electronic handover programs between nurses through Zoom ($\bar{x}$ 3.25, SD 1.29). In Item 20, just over two-thirds (n=75, 69.44%) of 108 (100.00%) respondents indicated their willingness to use IT in healthcare settings, allowing nurses more time to improve patient care.

5.2.2.4 Knowledge (Items 25-39)

The mean values of Items (Items 25, 34, 36, 37) in the dimension of knowledge in Factor 2 indicated that the highest mean values were obtained in Item 36 ($\bar{x}$ 4.47, SD 0.81) on how nursing units that use digital devices will require fewer nursing staff than in the past, and in Item 37 ($\bar{x}$ 4.25, SD 0.86) on how the movement towards robotic surgery will create an environment of assisting more patients in a shorter period.

In Item 25, less than two-thirds (n=69, 63.89%) of 108 (100.00%) respondents indicated their willingness to use IT in healthcare settings to improve high-quality patient care, versus just over a third (n=39, 36.11%) of 108 respondents who were unwilling to use IT and digital literacy, that were skills needed in the new era of healthcare, to provide patient care. *Significant differences between the different genders and nursing programmes* responses were found in Item 25 for the need for IT in healthcare to improve high-quality patient care.

More than half (n=58, 79.45%) of 73 (100.00%) female respondents indicated their willingness to use IT in healthcare settings to improve high-quality patient care, compared to fewer than one-tenth (n=9, 27.28%) of 33 (100.00%) male respondents who expressed their unwillingness that skills, such as IT and digital literacy, were not required to provide high-quality patient care. The responses obtained a high mean value of 4.05 with a normal distribution of the responses (SD 1.02) around the mean value, indicating that female students, to a larger extent, were *ready* to use IT in healthcare settings that could improve high-quality patient care.

In Item 34, more than three-quarters (n=86, 79.63%) of 108 (100.00%) respondents were willing to use digital devices or machines in healthcare settings, and to have a higher level of education when operating these devices. Nearly a quarter (n=22, 20.37%) of respondents indicated their unwillingness to become equipped with digital literacy skills, while also having diverse responses on the extent of their *readiness* to use digital devices in healthcare settings ($\bar{x}$ 4.22, SD 0.94).

In Item 36, just the majority (n=93, 86.11%) of 108 (100.00%) respondents indicated that they were willing to use digital devices that would require fewer nursing staff than currently, versus only 15 (13.90%) of the respondents who were unwilling to participate in nursing units that are making use of digital devices that require fewer nurses ($\bar{x}$ 4.47, SD 0.81).

In Item 37, less than three-thirds (n=92, 85.19%) of 108 (100.00%) respondents indicated their willingness that the movement towards robotic surgery, creates an environment of assisting more patients in a shorter period, compared to the sixteen (n=16, 14.81%) respondents who indicated their unwillingness that the traditional hands-on approach of surgery by humans could be replaced by robots ($\bar{x}$ 4.25, SD

0.86). *Significant differences between the year-level responses* were found in Item 37 on robotic surgery, which creates an environment of assisting more patients in a shorter period.

More than one-quarter ($n=30$, 60.00%) of 50 (100.00%) respondents in the 3rd-year, and ($n=28$, 48.27%) of 58 (100.00%) in the 4th-year, were willing to participate in robotic surgery that creates an environment of assisting more patients in shorter periods. Nearly half ($n=50$, 46.30%) of the respondents in both year levels were unwilling in their responses to participate in using robotic surgery in healthcare to assist more patients over a shorter period. The respondents obtained a normal mean value of 3.55 with a wide distribution of the responses (SD 1.12) around the mean value, which indicated a diverse distribution of responses from students on the extent of their *readiness* to use robotic surgery.

The dimension of *knowledge* in Factor 3 indicated that the highest mean value was obtained in Item 31 ($\bar{x}$ 4.24, SD 1.00) on the use of cloud storage that could improve the accessibility of patient information, while reducing wastage.

In Item 30, less than two-thirds ($n=69$, 63.88%) of 108 (100.00%) respondents indicated their total willingness to make use of medical online software for patients to participate in completing their medical history, and to facilitate more accurate diagnoses. Just over a third ($n=39$, 36.11%) of the respondents were unwilling and indicated that patients will be unable to complete their medical history online through online software programs ($\bar{x}$ 3.87, SD 1.09).

In Item 31, more than three-quarters ($n=88$, 81.48%) of 108 (100.00%) respondents were willing to use cloud storage for patient information to improve the accessibility of patient information, while reducing wastage ($\bar{x}$ 4.24, SD 1.00), versus less than a quarter ($n=20$, 18.51%) of the respondents who indicated their unwillingness to use cloud storage for patient information.

More than two-thirds ($n=77$, 71.29%) of 108 (100.00%) respondents were willing to use 3D printing to create prosthetics or customised dental devices to improve patient care compared to less than a third ($n=31$, 28.70%) of the respondents who indicated their *unwilling to neutral* responses for using 3D printing to create prosthetics and dental implants to improve patient care ($\bar{x}$ 3.98, SD 0.99).

In Item 39, more than two-thirds (n=77, 71.30%) of the respondents indicated their willingness to use RFID technology to improve patient care. However, just over a quarter (n=31, 28.70%) of the respondents were unwilling to use RFID technology in the workplace to improve patient outcomes.

5.3 RECOMMENDATIONS

Recommendations are used to call for action on the problems investigated in a study. Research recommendations are important elements of academic and professional studies (Menzies, Sabert, Hassan et al., 2024; Luft et al., 2022). They offer practical recommendations and suggest future pathways based on the research project's results (Lim, 2024). In this study, the three factors were arrived at through the data analysis. The recommendations in this report highlighted specific explanations and methods that can be applied based on the findings in the study. The recommendations allowed the researcher to suggest specific interventions to address the problems and limitations identified in their study (Busetto et al., 2020).

According to Khurniawan, Irmawaty and Supriadi (2024), Kini, Duluk and Weinstein (2023) and Hammerton, Benson and Sibley (2022), digital readiness is defined as the drive and ability of an individual, such as a student, to accept, apply, and develop digital healthcare technologies effectively.

The recommendations of this study were described according to (i) 3 factors, (ii) four dimensions of *psychological awareness, social and interpersonal relationships, skills development, knowledge*, and (iii) referring to practice, education, research, and nursing management. In these recommendations, reference is made to the contribution of nursing practice, education, and research.

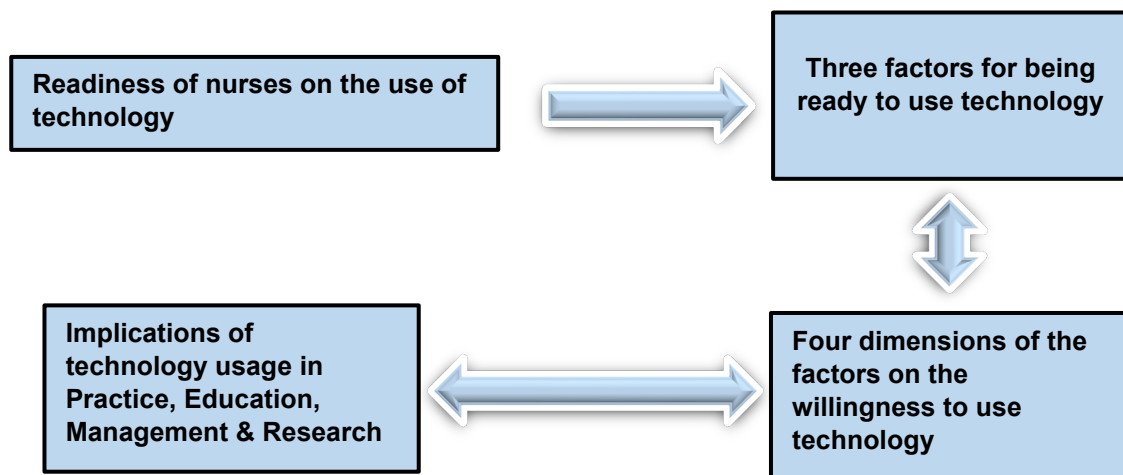


Figure 5.1: Recommendations for a proposed schematic framework on the readiness of nurses in a public hospital to use digital technology

5.3.1 Recommendations on the use of digital technologies for nursing students in healthcare practices

Student nurses need to recognise the improvements that the role of IT brings to the delivery of effective nursing care

The nursing practices in the healthcare profession are slowly using digital technologies to increase patient care and education (Margallo, Walker-Vischer & Godin, 2024; Tsarfati & Cojocaru, 2022). Students should gradually be made aware of the goal of digital health technologies (DHTs) that can improve health and nursing care practices worldwide (Borges do Nascimento, Abdulazeem, Vasanthan et al., 2023). Using digital technologies, such as telehealth programs and mobile devices such as iPads, allows students to be ready for their future role as Professional Nurses in the new era of healthcare (Rutledge & Gustin, 2021). Digital technologies have many benefits, such as remote online consultations, counselling on pain management, and monitoring a patient's vital signs. This is also indicated in studies done by Madanian, Nakarada-Kordic, Reay et al. (2023) and Janjua, Carter, Threapleton et al. (2022).

Students must accept that ICT can offer meaningful benefits in achieving health objectives and have insight into what health outcomes can be achieved (Megbowon &

David, 2023). According to Shojaei, Vlahu-Gjorgievska and Chow (2024) as well as Rosenlund, Kinnunen and Saranto (2023), ICT in healthcare settings can be used for electronic health records, online surveillance systems, important registrations such as births and deaths, and for telemedicine that can assist with distant online healthcare or patient education (Jayousi, Barchielli, Alaimo et al., 2024; Tahsin, Armas, Kirakalapraphathan et al., 2023).

In **nursing practice**, challenges to the use of digital technologies by nurses must be focused on, and nursing managers must show leadership abilities when introducing new technologies into the healthcare setting (Laukka et al., 2023). They must reflect on their important role in managing the different categories of nurses as well as patients and add detailed topics of interest to nursing training to develop the acceptance of new communication and technological skills (Mohamed, Alhujaily, Ahmed et al., 2024; Kwame & Petrucka, 2021). AI technologies can provide the profession with major benefits in data analytics and advanced clinical decision support, e.g., improved patient outcomes and effective workflow (Khosravi, Zare, Mojtabaeian & Izadi, 2024).

According to Rony et al. (2024a), it is foreseeable that AI technologies will be used more frequently to support and expand the cognitive, decision-making, and possibly labour functions of nurses. The increased use of AI in healthcare settings brings legal and ethical consequences (Mennella, Maniscalco, De Pietro et al., 2024; Petersson, Larsson, Nygren et al., 2022). It is recommended that the nursing profession assess its role, practices, and knowledge against developing ethical frameworks that investigate the opportunities and risks that AI and other ground-breaking technologies bring (Rony et al., 2024b; Seray-Wurie, Hawker & Chitongo, 2020).

It is recommended that healthcare settings support the involvement of patients in the development and implementation of new, ground-breaking technologies. Further research, funding, and leadership in this field are needed to assist in supporting the development of new practice policies and ethical guidelines to guide nursing practice in the new healthcare era (Leslie, Bourgeault, Carlton et al., 2023; Cheraghi, Valizadeh, Zamanzadeh et al., 2023).

Initiating a changed perspective on using IT devices in delivering nursing care

In nursing education, training on digital health technologies must be completely integrated into the undergraduate and postgraduate curricula at HEIs. The continuous professional development in digital health must form part of the training portfolio of all nursing students. Therefore, nursing competencies in digital health technologies must be well-defined and formally evaluated (Frøiland, Husebø, Aase et al., 2023).

According to Labrague, Aguilar-Rosales, Yboa et al. (2023), knowledge of nursing students on using healthcare technologies and how it will benefit themselves and their patients must become a priority. Nurse educators must be motivated to offer new teaching methods for content delivery and remote learning opportunities (Tsarfati & Cojocar, 2022). According to Jakoet-Salie and Ramalobe (2023) universities must focus on three important areas to prepare students for the use of digital technologies in HEIs; (i) *providing ICT infrastructure*, (ii) *creating educational platforms* and (iii) *providing training to their nursing staff on the use of these technologies* e.g., by creating online courses.

Digital readiness for nursing students involves their technology-related knowledge, skills, attitudes, and competencies on using digital technologies to meet the educational goals and expectations in higher education (Dallora, Andersson, Gregory Palm et al., 2024; Massaro, 2021). Therefore, it remains the responsibility of HEIs to keep up with digital transformation as it has become a prerequisite for them in the 21st century. According to Baako and Abroampa (2023), integrating ICT into higher education environments is a universal trend, seen as a network to allow educational restructuring and the development of communication platforms.

It is recommended that ***nursing education*** incorporate digital tools into healthcare settings to facilitate the *knowledge and skills* in the learning process of nursing students (Gause et al., 2022). The combination of digital technologies can be important to support the delivery of content and for the use of technology by nurses. Nursing students can therefore have a mutual perception of how digital technologies can support their learning in clinical practice (Nuuyoma et al., 2023; Lekalakala-Mokgele et al., 2023).

It is recommended that HEIs *reform nursing education* by designing educational programmes at undergraduate and graduate levels regarding informatics and digital health (Nxumalo, Pillay & Mchunu, 2024). These programmes should include opportunities to work with and learn from computing, engineering, and other interdisciplinary colleagues. According to Burgess and Honey (2022), the nursing profession will need a crucial number of nurse specialists who understand and possess skills in using digital technologies. These nurse specialists should also have digital savviness and the courage to lead the development of new models of patient care allowed by digital technologies in the forthcoming industries (Hammarén, Pölkki & Kanste, 2024).

Nursing education should expand its competencies and curriculums proactively to increase the use of digital technologies in all areas of practice (Raghunathan, McKenna & Peddle, 2023; Dogan, Dogan & Celik, 2021). HEIs are advised to integrate innovative educational methods and cutting-edge technologies, such as virtual and augmented reality, to enhance simulation-based education. According to De Gagne (2023), it is highly recommended for HEIs to integrate ICT meaningfully into their nursing curricula to develop deep learning with an approach of education through instruction, and not education with instruction. HEIs and healthcare services can offer supervised access to the Internet for nurses in chosen shared areas such as staff tearooms, or to access Wi-Fi or the Internet on their mobile phones (Cui, Tong, Wang et al., 2024).

Addressing the issue on the security of future roles for nursing staff in a changing nurse-patient environment

Nursing management plays an important role in the successful implementation of DHTs, and if trusted, can boost its implementation (Strudwick, Booth, Bjarnadottir et al., 2019). Therefore, a favourable nursing setting must be initiated through a positive level of organisational readiness for digital transformation (Kruszyńska-Fischbach, Sysko-Romańczuk, Rafalik et al., 2021).

Education of nurses is needed to prepare for the forthcoming industries, and therefore, healthcare settings must begin with the immediate transformation into a

digitally empowered profession (Mlambo et al., 2021). However, challenges for nurses are ongoing in using digital technology by nurses (Livesay et al., 2023).

Nursing managers are recommended to enhance staff security by conducting demonstrations and evaluations for nurses on the use of digital health technologies, such as electronic medical records and telemedicine. These DHTs are much needed in specialised units to prevent failures in the current technological systems (Mensah et al., 2024). It is also recommended that nursing managers explain to nursing staff the increased benefits of DHTs for nursing practices and promote the use of technology in primary care settings (Altmiller & Pepe, 2022).

An ongoing concern is that nurses have generally not kept pace with the fast changes in digital technologies and their impact on society. According to Chipps et al. (2022), poor access to mobile networks and the slow speed of the internet can be identified as barriers to ICT understanding and awareness among nurses in South Africa. However, South African nurses are eager to become competent ICT users (le Roux, Bimerew & Chipps, 2024; Bester et al., 2021). Therefore, it is important that HEIs support and make students aware by offering ICT infrastructure and developing their computer skills (Hanaysha, Shriedeh & In'airat, 2023).

With the fast-changing technological setting concerning new technologies such as AI, it is recommended that it would be best for HEIs and healthcare providers to cross technological gaps earlier rather than later, to guarantee staff security within the workplace (Zirar, Ali & Islam, 2023).

Essentially, as machine technologies will not be able to replace nursing practice, nurses need not be worried about the security of their employment (Olorunfemi & Akinyemi, 2024). When challenged by the rise of technology in healthcare, nurses are ready and willing to develop professionally and become better versions of the outstanding healthcare workers that they are (Nilsen, Seing, Ericsson et al., 2020).

5.3.2 Recommendations on the use of digital technologies for nursing students in nursing education in HEIs

Nursing students need to recognise the improvements that the role of IT brings to the delivery of effective nursing care

Digital Health Technology (DHT) in nursing uses different tools and technological developments to improve patient outcomes (Dodson, Haase, Jeffreys et al., 2024). DHT facilitates better communication between nurses and increases effectiveness in healthcare settings (Wong et al., 2024). The nursing practice could develop an educational discussion platform for nurses, as nursing students should become much more familiar with using digital devices. In line with the opinion of Albagawi, Alsalamah, Alharbi et al. (2024) and Khalil, Hantira and Alnajjar (2023), the integration of electronic devices in the clinical environment of nursing students can help stimulate their interest in technology and improve their participation in the nursing care of their patients. Therefore, nurses can spend less time on administrative tasks and more time on patient care (Motsaanaka, Makhene & Ndawo, 2024). The use of electronic medication administration records (eMARs) will allow nurses to record medication administration electronically, therefore removing the need for paper-based records (Park et al., 2024; Naamneh & Bodas, 2024; Karnehed, Erlandsson & Norell Pejner, 2022).

Student nurses should acknowledge that technology in nursing can transform communication among nurses, and lead to improved collaboration and better nursing care of patients (Pulimamidi, 2024). Using telehealth technologies can make it easier for nurses to, after their training, communicate remotely with patients and doctors to provide suitable healthcare and to reduce the need for inpatient appointments (Charlly & Swedlund, 2024). Students are starting to use mobile devices such as iPads, smartphones, and tablets, allowing them to communicate with their peers and other healthcare workers (Folger, Merenmies, Sjöberg et al., 2021). These devices should be used to teach them how to access patient information and improve nursing care management of patients (Gonçalves-Bradley et al., 2020).

Nurse educators should develop nursing curricula proactively to prepare and equip students with the required competencies for using the many digital technologies available for healthcare practices (le Roux et al., 2024). It is recommended that HEIs incorporate new teaching methods such as virtual and augmented reality technologies

to provide features of simulation-based education (Kosmas, Nisiforou & Vrasidas, 2024). The combination of technology into the WIL component of nursing curricula could not only offer students a combined learning experience but also allow them to stay more interested in patients associated with DHTs, without being side-tracked (Marougkas, Troussas, Krouska et al., 2023; Bester et al., 2021). Digital technologies must be integrated into the teaching, learning, and clinical work environment of nursing students because they are directly associated with online learning (Haanes, Nilsen, Mofossbakke et al., 2024). The adoption of DHTs will enable benefits such as convenience, fast access to patient information, self-assessment, and ongoing exposure to technology (Balalle, 2024; Nuuyoma et al., 2023). It is therefore recommended that HEIs employ nurse educators possessing tech-savviness abilities, and the courage to lead the development of new models of patient care allowed by digital technologies (Hammarén et al., 2024).

According to Okolo, Ijeh, Arowoogun et al. (2024), all levels of **nursing management** must invest and advocate more actively for a profession that is both balanced and expanded by digital technology. The profession needs to change its use of digital technology through the ongoing support of nurses to become knowledgeable and to develop new scientific knowledge on information analysis, virtual examples of nursing care, and the co-design of digital treatment plans for patients (O'Connor, Gibson, Lewis et al., 2023).

Retaining an important number of **nursing managers** who understand the future and unforeseen consequences along with opportunities of these kinds of technologies is important to guarantee the quality and safety of the nursing profession (Buller, Hodo & Williams, 2024). Opportunities for nurses of all specialities must be offered to add to the development and application of digital healthcare policies in their workplace and worldwide (Lottonen, Kaihlanen, Nadav et al., 2024). According to Padovano and Cardamone (2024), the profession should re-evaluate cultural understandings of technologies such as drones, robots, and other AI-enabled practices that can be regarded as benefits to the nursing practice, rather than challenges. Collaboration with technology developers, suppliers, and patients will be important to guarantee the success of this understanding (Sony, Antony & Tortorella, 2023).

Initiating a changed perspective amongst students on using IT devices in delivering nursing care

According to Mohammadnejad et al. (2023), using digital technology can be important for healthcare institutions to improve health, quality of life, and well-being of patients. Students need to adopt a mindset that recognises how technology in healthcare settings can enhance the quality of patient care (Cabero-Almenara, De-La-Portilla-De-Juan, Barroso-Osuna et al., 2023). They should have a changed perspective toward the correct use of technological equipment that can help them to guarantee a safe and highly operational work environment for themselves (Jedwab, Manias, Redley et al., 2023).

Owing to the introduction of new digital technologies such as AI, positive attitudes of nurses concerning the integration of AI in future nursing care are highly advised (Rony et al., 2024b). Nursing students should develop an *awareness* regarding ICT as a tool for speedy and easy access to information (Bester et al., 2021). This requires that nursing education institutions train and support students by offering ICT infrastructure (hardware) in educational opportunities and developing student nurses' computer skills (Sunnasy & van der Heever, 2024). HEIs should be accessible to learn more and to adopt ICT to improve the learning experience of students (Mashau & Nyawo, 2021). This approach not only facilitates the learning process of students but also adds to the decision-making skills of students in the classroom and their clinical work environment (Wagino, Maksum, Purwanto et al., 2024).

Nursing education must slowly introduce the automation of routine nursing tasks during training, such as medication reminders and documentation, allowing nurses to dedicate more time to patient-centered care (Yelne, Chaudhary, Dod et al., 2023). Nurses must know why they should use new technologies in healthcare and have the knowledge and skills to use them (Jedwab et al., 2021). According to Alowais et al. (2023), the possible negative effects of introducing new technology in the healthcare setting must be understood and eased to guarantee the continuation of safe and high-quality patient care. Students, including senior nurses, should be important role players in the multi-disciplinary team during discussions around new technology implementation that may affect their work or workflow (van Houwelingen, Meeuse & Kort, 2024).

Addressing the issue on security of future roles for nursing staff in a changing nurse-patient environment

The use of technology is gradually important in nursing education and healthcare practice (Mohammadnejad et al., 2023). There is already a robotic transformation in healthcare wherein robots have made nursing tasks and procedures more efficient and safer (Weerarathna, Raymond & Luharia, 2023). Developments in healthcare technology are slowly being made available to help nurses perform their daily tasks and to care for patients more efficiently and safely (Farokhzadian, Khajouei, Hasman et al., 2020). The nursing profession mandates that student nurses are taught to think critically and to make positive decisions to deliver nursing care with competence (Karaca, Kaya & Kaya, 2023).

The ongoing application of technological developments in nursing is important for most healthcare organisations (van Houwelingen et al., 2024; Dykes & Chu, 2021). Nurses joining these workplaces should be ready and accept new technological developments such as robotic medical devices that can identify and monitor the well-being of patients, assisting with procedures and surgeries, and manage important nursing functions (Deo & Anjankar, 2023).

Students must understand that technology has also become a means that can reduce the workload of nurses to allow them to be more efficient and happier about their jobs (Alshammari & Alenezi, 2023). Utilising developments in nursing technology can reduce staff burnout and improve staff retention levels (Wilton, Sheffield, Wilkes et al., 2024). It is confirmed that technological developments are happening at a non-stop pace, thereby transforming human health and wellness care (Katsoulakis, Wang, Wu et al., 2024). According to Paul et al. (2023) a change in the healthcare sector brought along by the 4IR are caused by among other things technological developments. Although technological developments are good for the transformation of human health it can also cause psychosocial problems such as job insecurity among nurses (Berardi, Antonini, Jordan et al., 2024; Kaihlanen et al., 2023). These speedy developments can have a huge impact on their uncertainty around their future roles as Professional Nurses. According to Rony et al. (2024b) and Seibert, Domhoff, Bruch et al. (2021), AI is part of digital technology and students must accept that it is already functioning in

many areas in the nursing field. It is currently used at a slow pace and should be more often used for the drawing up of nursing care plans for treatment, the assistance of repetitive jobs, and in managing medication administration. Chaharsoughi, Ahmadifaraz and Kahangi (2022) mention that the use of digital technologies in nursing practice is increasing due to the significant role in patient care. Nurses thus fear that the growing acceptance of AI may also force them out of their jobs (Rony, Parvin, Wahiduzzaman et al., 2024c). The importance of nurses trained to show their role and work along with technological practices is indicated by a study done by the McKinsey Global Institute estimated that 800 million workers worldwide could be replaced by robots by the year 2030 (Bazargani & Deemyad, 2024).

According to Kamińska, Zwoliński, Laska-Leśniewicz et al. (2023), active teaching strategies using technology to improve student learning have replaced redundant and dormant methods from the past. It is recommended that nurse educators include educational technologies such as simulation and virtual simulation as part of their lesson plans and teaching strategies to prepare nursing students for their future roles as Professional Nurses (Matlhaba, 2023). Nurse educators should use skill laboratories in a controlled setting, including simulation and virtual simulation as teaching strategies (Koukourikos, Tsaloglidou, Kourkouta et al., 2021). This enables nursing students with the required learning opportunities to apply quality and safety competencies in the workplace, and to foster a safety mindset in nursing (Sherwood, 2021; Nel et al., 2021). These approaches support the engagement of the learner and encourage adult learning principles of being self-directed, experiential, relevant, and problem-centred (Darling-Hammond, Flook, Cook-Harvey et al., 2020; Gronseth & Hutchins, 2021).

The changing landscape of healthcare, along with the ongoing entry of new equipment, policies and procedures, requires nurses to be technically skilled (Al-Hassan & Al Omari, 2023). Nurses will need to develop knowledge at all levels of education and practice in applying information to support national quality initiatives aimed at improving access to care, along with the management of care (Nyelisani, Makhado & Luhlima, 2023). It is also recommended that healthcare systems hire nurses with competencies (knowledge, skills, attitudes and values) in technology to use digital platforms, AI and other technological developments to address social causes of health and health equity (Cary, De Gagne, Kauschinger et al., 2024; Washington, Franklin,

Huang et al., 2023). Further recommendations are that training for technological skills must begin in the pre-accreditation of nursing education programmes and be further supported in healthcare practice settings and advanced practice education (Jeffries, Bushardt, DuBose-Morris et al., 2022). Using tablets and e-books instead of textbooks enables learners to have extended access to speedily updated information (Wu, Lu & Huang, 2023).

5.3.3 Recommendations on the use of digital technologies in healthcare for future research

Nursing students need to recognise the improvements that the role of IT brings to the delivery of effective nursing care

Butcher and Hussain (2022) think that digital technologies have the potential to overcome the current problems and challenges facing the healthcare sector. The shortage of skilled professionals, such as nurses and other healthcare staff, led to an increased demand for long-term patient care due to ongoing demographic changes (Matseke, 2023). The field of innovative digital technologies that is developed to support *nursing care* is extensive (Huter et al., 2020). Therefore, more research on the role that digital technologies can play to improve nursing care must be performed worldwide (Chaharsoughi et al., 2022).

It is recommended that more research on technology in healthcare be done to reduce the fast-growing demands for skilled healthcare workers in countries affected by demographic changes. Technological inventions such as AI and the latest software program ChatGPT have significantly changed the formation and organisation of the healthcare sector (Bamel et al., 2023). AI has affected nursing since the early 1980s by changing the nursing profession through assistive robotics (Mahmoudi & Moradi, 2024). The potential improvements AI can offer to healthcare settings are changing daily nursing duties such as patient recordkeeping, wound care, patient education, and medication administration (Encarnação, Manuel, Palheira et al., 2024). Nurse educators can invest more in AI software programs such as ChatGPT that can create artificial patient interviews and other simulation cases as combined learning tools used by nurses (Glauberaman, Ito-Fujita, Katz et al., 2023).

AI in nursing could improve the organisation of patient referrals and treatment plans and provide all the important information needed for doctors and nurses to make appropriate decisions (Petersson, Larsson, Nygren et al., 2022).

It is recommended that nurses continuously improve their clinical practices to stay smart and updated for healthcare providers and the new era of healthcare 4.0. (Aranyossy & Halmosi, 2024). They should include new developing technologies in their daily workload to achieve more advanced duties and responsibilities (Altmiller & Pepe, 2022). There is a need for more high-quality studies to support the evidence of the effectiveness of digital technologies for nursing care.

More added future research on outpatient, informal, and cross-sectoral patient care should be done to utilise the potential of digital technologies (Busse, Nitsche, Kernebeck et al., 2022). This will not only focus on improving the independence of care recipients, but also on relieving the burden of ongoing care from formal and informal carers.

Initiating a changed perspective on using IT devices in delivering nursing care

The future practice of nursing in a technologically developed future would surpass the use of nursing interventions to achieve an expected outcome (Xavier & Nunes, 2024). According to Mahmoudi and Moradi (2024) and Vasquez et al. (2023), many nursing duties are allocated to machines and AI due to technological advances occurring. It is recommended that students should learn more about emerging technologies in healthcare and gain more exposure and continuous orientation on how to operate digital devices in specialised units (Junaid et al., 2022). If nurses don't learn or are exposed to digital technologies in nursing as part of the healthcare setting, they might get replaced or grow frustrated when AI machines do their tasks more competently (Mansour & Nogues, 2022).

Apart from the current changes in nursing education, more emphasis is recommended on researching and developing technologies in the nursing field (Meum, Koch, Briseid, et al., 2021). The number of new technologies being developed in the nursing field can improve the quality of patient care and create more favourable working conditions for nursing staff (Mlambo et al., 2021). According to Alshammari and Alenezi (2023),

nurses should be involved in selecting which aspects of their practice can be allocated to technology. The involvement of more nurses in the development of technology would guarantee the combination of the human caring attitude and the encouragement of person-centred care (Ghanbari-Afra, Adib-Hajbaghery, Dianati, 2022). More research is needed to determine the outcome of this new technology in nursing and how to fast-track its acceptance in nursing practice.

Address the issue on the security of future roles for nursing staff in a changing nurse-patient environment

According to Berg, Green, Nurski et al. (2023), technology has an impact on job quality determination worldwide. Healthcare settings are changing daily, and so are the employment conditions of nurses (Llop-Gironés, Vračar, Llop-Gironés et al. 2021). These technological changes have a mental effect on determining job security among healthcare workers and have significantly increased the *job insecurity* factor among healthcare workers (Ghani, Memon, Han et al., 2022). Due to the fast developments in automation and AI, technology has replaced the human workforce, and job insecurity is becoming a strong stressor in the present healthcare era (Mabungela, 2023).

Healthcare technology is making working conditions and life easier for healthcare providers and patients, also increasing *job insecurity* among nurses (De Leeuw, Woltjer & Kool, 2020). As a result of technological changes, healthcare settings are faced with uncertainty to guarantee employment permanency among nurses (Farokhzadian, Mangolian Shahrabaki, Farahmandnia et al., 2024). Therefore, the insecurity of nurses about their future role in a changing nurse-patient environment has increased because of new technologies.

Changes in the nursing environment are an important part of nursing practice (Pereira, Ribeiro, Mendes et al., 2024). According to Mabona et al. (2022), it is recommended that healthcare providers prioritise the mental and physical well-being of the nurses by nurturing a favourable working environment to guarantee that staff perform at their best. A favourable and supportive working environment can result in positive patient outcomes, guaranteeing healthcare workers achieve their goal of caring for their patients (Maassen, van Oostveen, Vermeulen et al., 2021). It is also recommended

that *nursing managers* and important shareholders identify factors that can reduce resistance among nurses and pay special consideration to this before making changes (Cheraghi, Ebrahimi, Kheibar et al., 2023). In doing this, nurses can provide safe and quality patient care and improve the level of health and patient satisfaction (Cheraghi et al., 2023; Jankelová & Joniaková, 2021).

It is recommended that it becomes the responsibility of all *nursing managers* and healthcare management to ensure that nursing staff receive applicable training to manage the new technology being introduced in healthcare settings. It is also recommended that *nursing managers* should ensure that new technology is not introduced too rapidly, and that staff have enough time to adjust to the current system and in effect, are given time to change to the new system as well (Kunkel, Tietze, Wilson, Fant, Rivard, Belchez, Forman & Husson, 2024). Workshops on DHTs should become an institutional policy to ensure nursing staff get enough exposure to digital technologies and how to operate these technologies (Kissi, Azakpah, Mensah et al., 2024; Okoye, Hussein, Arrona-Palacios et al., 2023).

Key policymakers should develop practical and attainable policies and offer essential training opportunities to healthcare workers on using digital health technologies. They should be encouraged to bring an improved level of Human Resources (HR) policies to boost the confidence and self-esteem among workers (Makapela & Mtshelwane, 2021; Hajizadeh, Zamanzadeh, Kakemam et al., 2021). Improved HR policies make employees feel more secure and productive in their jobs (Zhenjing, Chupradit, Ku et al., 2022).

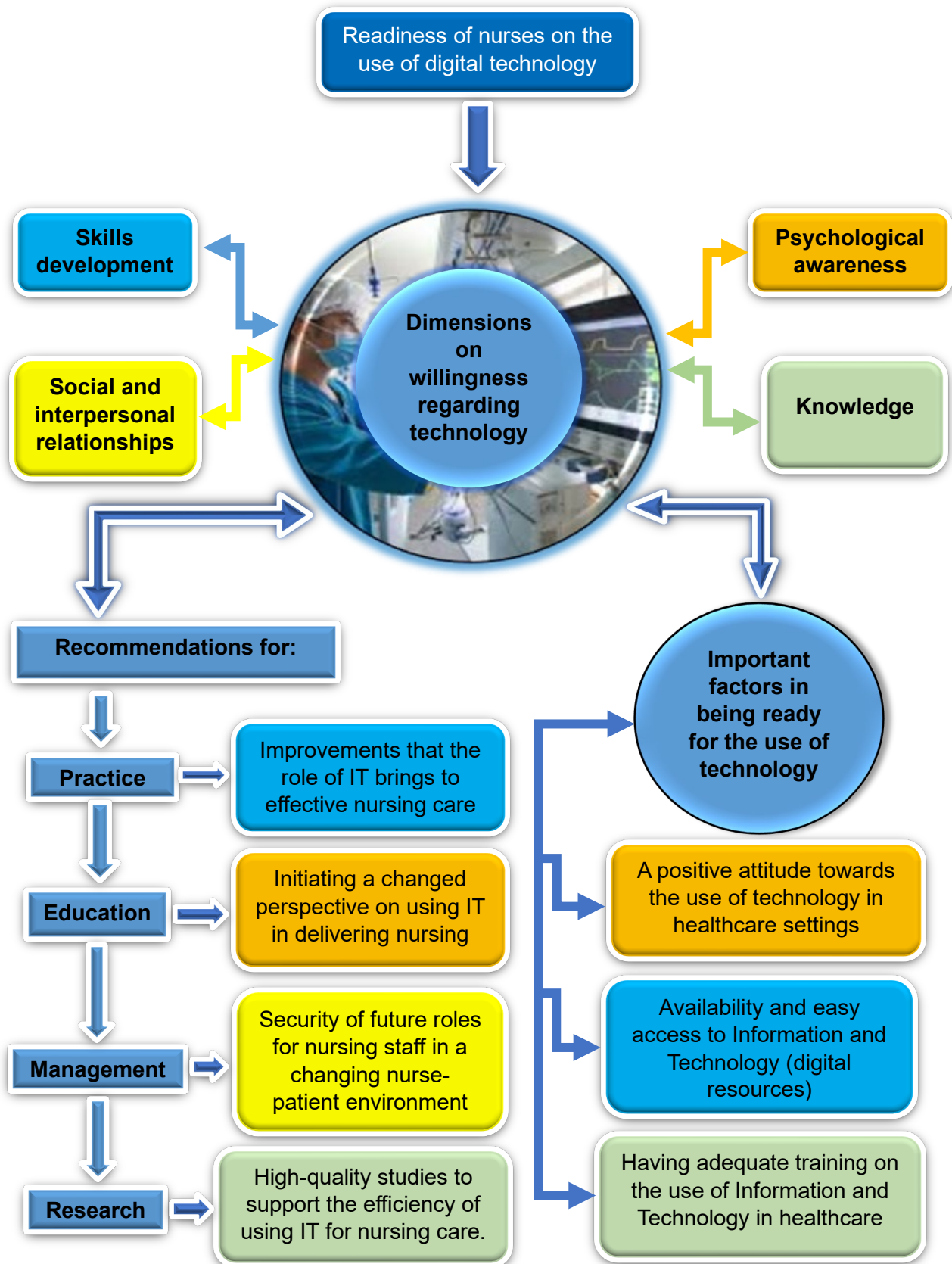


Figure 5.2: Proposed schematic framework on the readiness of nurses in a public hospital to use digital technology in their nursing practice

According to Zhang and Ibarra (2024), recommendations should be concrete and specific. It must be supported with clear reasoning and directly connected to the research objectives. Recommendations should be written in a manner that highlights approaches so that other researchers can reproduce or duplicate the results to draw further conclusions (Moreau & Wiebels, 2023). Recommendations should suggest different directions that future research studies could follow, if appropriate (Chiu, 2024). The recommendations of the study brought about a proposed schematic framework that incorporates the aspects investigated in this study on the readiness of nurses to use digital technology. This framework can form the basis for another study to investigate the relationships of these variables as outlined in the proposed framework (Figure 5.2).

5.4 LIMITATIONS OF THE STUDY

Limitations in research refer to any restrictions to your study based on the research methodology and design (Theofanidis & Fountouki, 2019). Limitations are restrictions that the researcher cannot control in their study. Limitations highlight opportunities for any future research and boost a study's credibility (Montgomery, 2023; Ross & Bibler Zaidi, 2019). The study identified some limitations in the progression of the study, which are presented as follows:

- (i) The study was conducted at one of the four (4) academic nursing training institutions in the Western Cape. Therefore, the findings cannot be generalised to the other three (3) academic nursing training institutions in the Western Cape. Future research on the readiness to use digital technology in healthcare facilities needs to be conducted in other nursing training institutions of the Western Cape to ascertain an overall estimation of the readiness of nursing students to use digital technology in healthcare facilities.
- (ii) The instrument was reliable and obtained an overall high Cronbach's Alpha (α) of 0.831. The study only focused on 3rd and 4th year undergraduate nursing students. A larger study population could have given more comprehensive findings, e.g., indicated if more significant differences between junior and senior students existed on the phenomenon.

5.5 CONCLUSION

Nursing is gradually integrating digital technologies to improve patient care and education. The introduction of digital technologies can provide better accessibility and flexibility of healthcare for the public. However, it is still a new development in practice, especially in public hospitals. Mobile devices, particularly smartphones and health applications, can enable nurses to offer high-quality nursing care to outpatients. The willingness of students to implement digital technology should be enhanced through nursing education. Innovative pedagogical approaches to present the programme content should create a learning environment where students are aware and willing to use these devices in practice.

However, despite significant advances, challenges in nurses' use of digital technology persist. This limits the potential benefits they bring to nursing practice and patient care. To maximise the benefits of digital technologies, nursing must begin the immediate transformation into a digitally enabled profession that can respond to the complex global challenges facing health systems and society. The profession must consider its role, knowledge, and relationships with technologies and patients to remain relevant in digitally enabled societies and healthcare systems and continue to provide compassionate care in a digital world.

The results of this study showed that despite the few challenges and disadvantages reported regarding technology use, its use continues to grow extremely rapidly. Furthermore, the study showed that technology in nursing education is used in both clinical and classroom teaching to complement the learning of students. However, there is still a gap in acceptance despite its upward trend. To meet the demands of the 4IR and the upward trend of technology use, the author of this study recommends that further studies should explore the acceptance of technology use by educators and students in nursing education. Also, further research is recommended on students' and educators' attitudes towards technology use for teaching and learning in nursing education.

REFERENCES

- Abdi, S. 2023. A Comprehensive Guide for Selecting Appropriate Statistical Tests: Understanding When to Use Parametric and Nonparametric Tests. *Open Journal of Statistics*, (13):464-474. <https://doi.org/10.4236/ojs.2023.134023> [Accessed 22 September 2023]
- Abdulai, A-F. & Hung, L. 2023. Will ChatGPT undermine ethical values in nursing education, research, and practice? *Nursing Inquiry*, 30: e12556. <https://doi.org/10.1111/nin.12556> [Accessed 10 June 2024]
- Abdulrauf, L., Adaji, A. & Ojibara, H. 2024. Clarifying the legal requirement for cross-border sharing of health data in POPIA: Recommendations on the draft Code of Conduct for Research. *South African Journal of Bioethics and Law*, 17(1): e1696. <https://doi.org/10.7196/SAJBL.2024.v17i1.1696> [Accessed 20 July 2024]
- Abid, H., Mohd, J., Ravi Pratap, S. & Rajiv, S. 2021. Telemedicine for healthcare: Capabilities, features, barriers, and applications. *Sensors International*, (2):2666-3511. <https://doi.org/10.1016/j.sintl.2021.100117> [Accessed 12 September 2022]
- Abo El-Naga, M.A., Eid, N.M. & Mahfouz, H.H. 2024. Enhancing Nursing Personnel-physicians' Communication and Collaboration: Its Effect on Nursing Productivity. *Benha Journal of Applied Sciences*, 9(4):81-94. <https://doi:10.21608/bjas.2024.279538.1373> [Accessed 20 July 2024]
- Abo Elmagd, M.H. & Alharbi, M. 2024. Nursing Students' Beliefs and Willingness to Implement Evidence-Based Nursing Practice at Umm Al-Qura University: A Descriptive Cross-Sectional Study. *Cureus*, 16(4): e58521. <https://doi:10.7759/cureus.58521> [Accessed 22 July 2024]
- Abrahams, A. 2023. How to use ChatGPT as a learning tool. *American Psychological Association*, 54(4):67. <https://www.apa.org/monitor/2023/06/chatgpt-learning-tool> [Accessed 17 September 2023]
- Abuhamda, E., Ismail, I. & Basharat, T. 2021. Understanding quantitative and qualitative research methods: A theoretical perspective for young researchers. *International Journal of Research*, (8):71-87. <https://doi.org/10.2501/ijmr-201-5-070> [Accessed 13 February 2023]
- Abuhammad, S., Alzoubi, K.H., Al-Azzam, S.I. & Karasneh, R.A. 2020. Knowledge and Practice of Patients' Data Sharing and Confidentiality Among Nurses in Jordan. *Journal of Multidisciplinary Healthcare*, 13:935-942. <https://doi:10.2147/JMDH.S269511> [Accessed 10 June 2024]
- Abulela, M.A.A. & Khalaf, M. 2024. Does the Number of Response Categories Impact Validity Evidence in Self-Report Measures? A Scoping Review. *Sage Open*, 14(1). <https://doi.org/10.1177/21582440241230363> [Accessed 20 July 2024]
- Adeghe, E.P., Okolo, C.A. & Ojeyinka, O.T. 2024. A review of the integration of virtual reality in healthcare: implications for patient education and treatment outcomes. *International Journal of Science and Technology Research Archive*, 6(1):079–088. <https://doi.org/10.53771/ijstra.2024.6.1.0032> [Accessed 14 July 2024]
- Adel, A. 2024. The Convergence of Intelligent Tutoring, Robotics, and IoT in Smart Education for the Transition from Industry 4.0 to 5.0. *Smart Cities*, 7(1):325-369. <https://doi.org/10.3390/smartcities7010014> [Accessed 14 July 2024]

- Adeniyi, A.O., Arowoogun, J.O., Chidi, R., Okolo, C.A. & Babawarun, O. 2024. The impact of electronic health records on patient care and outcomes: A comprehensive review. *World Journal of Advanced Research and Reviews*, 23(2). <https://doi.org/10.30574/wjarr.2024.21.2.0592> [Accessed 14 August 2024]
- Adu, G. & Zuma, S.M. 2024. 'Contributory factors related to patient safety incidence: A nursing perspective'. *Health SA Gesondheid*, 29(0): a2296. <https://doi.org/10.4102/hsag.v29i0.2296> [Accessed 15 July 2024]
- Adu-Marfo, A.O., Kwapong, O.A.T.F., Oheneba-Sakyi, Y. & Miller-Young, J. 2024. Understanding teachers' usage of YouTube as a pedagogical tool: A qualitative case study of basic schoolteachers in Ghana. *E-Learning and Digital Media*, 0(0). <https://doi.org/10.1177/20427530241239393> [Accessed 18 July 2024]
- Afewerk, A., Tamene, A., Tesfaye, A., Tafa, A. & Gemedet, S. 2023. Status and Factors Affecting Patient Safety Culture at Dilla University Teaching Hospital: A Mixed-Method Cross-Sectional Study. *Risk Management Healthcare Policy*, (16):1157-1169. <https://doi:10.2147/RMHP.S419990> [Accessed 17 September 2023]
- Aggar, C., Gordon, C.J., Thomas, T.H.T., Wadsworth, L. & Bloomfield, J. 2018. Evaluation of a community transition to professional practice program for graduate registered nurses in Australia. *Nurse Education in Practice*, (32):101-107. <https://doi.org/10.1016/j.nepr.2018.03.005> [Accessed 24 July 2021]
- Ahmed, R. 2019. New Technology in Nursing Education and Practice. *Zagazig Nursing Journal*, 14(1):29-38. <https://10.9790/1959-0606012938> [Accessed 28 March 2023]
- Ahuja, K.R. & Lio, P. 2024. Does internal validity play a factor in ChatGPT's success? *Clinical and Experimental Dermatology*, 49(8):931–932. <https://doi.org/10.1093/ced/llae087> [Accessed 20 July 2024]
- Akbar, Z., Khan, R.A., Khan, H.F. & Yasmeen, R. 2023. Development and validation of an instrument to measure the Micro-Learning Environment of Students (MLEM). *BMC Medical Education*, 23(1):395. <https://doi.org/10.1186/s12909-023-04381-3> [Accessed 30 August 2023]
- Akpabio, I. & Ella, R. 2015. Nursing Informatics Preparedness of Graduate Nurses in Calabar, Nigeria. *International Journal of Humanities Social Sciences and Education*. <https://www.researchgate.net/publication/281905885> [Accessed 13 September 2023]
- Alanzi, T.M. 2023. Impact of ChatGPT on Teleconsultants in Healthcare: Perceptions of Healthcare Experts in Saudi Arabia. *Journal of Multidisciplinary Healthcare*, 14(16):2309-2321. <https://doi:10.2147/JMDH.S419847> [Accessed 15 October 2023]
- Alavi, M., Biros, E. & Cleary, M. 2024. Notes to Factor Analysis Techniques for Construct Validity. *Canadian Journal of Nursing Research*, 56(2):164-170. <https://doi:10.1177/08445621231204296> [Accessed 20 July 2024]
- Alawiye, T. 2024. The Impact of Digital Technology on Healthcare Delivery and Patient Outcomes. *E-Health Telecommunication Systems and Networks*, 13:13-22. <https://doi:10.4236/etsn.2024.132002> [Accessed 24 September 2024]
- Albagawi, B., Alsalamah, Y., Alharbi, M., Alrawili, R., Babkair, L.A., Allari, R., Alkharji, S., Abed, R. & Fawaz, M. 2024. The Livid Experiences of Saudi Nursing Students in Digital Clinical

Experience: A Phenomenological Study. *Cureus*, 16(2): e53830.

<https://doi.org/10.7759/cureus.53830> [Accessed 21 June 2024]

Alderwick, H., Hutchings, A., Briggs, A. & Mays, N. 2021. The impacts of collaboration between local healthcare and non-healthcare organizations and factors shaping how they work: a systematic review of reviews. *BMC Public Health*, 21(1):753. <https://doi.org/10.1186/s12889-021-10630-1> [Accessed 15 October 2023]

Aldoseri, A., Al-Khalifa, K.N. & Hamouda, A.M. 2024. AI-Powered Innovation in Digital Transformation: Key Pillars and Industry Impact. *Sustainability*, 16(5):1790. <https://doi.org/10.3390/su16051790> [Accessed 22 June 2022]

Alenezi, A., Alshammari, M.H. & Ibrahim, I.A. 2024. Optimizing Nursing Productivity: Exploring the Role of Artificial Intelligence, Technology Integration, Competencies, and Leadership. *Journal of Nursing Management*, 8371068. <https://doi.org/10.1155/2024/8371068> [Accessed 15 July 2024]

Alexander, K.E., Ogle, T., Hoberg, H., Linley, L. & Bradford, N. 2021. Patient preferences for using technology in communication about symptoms post hospital discharge. *BMC Health Services Research*, 21(1):141. <https://doi.org/10.1186/s12913-021-06119-7> [Accessed 4 June 2023]

Alizadeh, H., Sharifi, A., Damanbagh, S., Nazarnia, H. & Nazarnia, M. 2023. Impacts of the COVID-19 pandemic on the social sphere and lessons for crisis management: a literature review. *Natural Hazards (Dordr)*, (10):1-26. <https://doi.org/10.1007/s11069-023-05959-2> [Accessed 14 October 2023]

Alkhaqani, A. L. 2023. ChatGPT: How Can It Impact Nursing and Health Science Education? *Al-Rafidain Journal of Medical Sciences*, (5):112–113. <https://doi.org/10.54133/ajms.v5i.209> [Accessed 31 August 2023]

Almeida, D., Figueiredo, A.R. & Lucas, P. 2024. At Work in a Hospital Setting: A Scoping Review. *Healthcare*, 12(2):173. <https://doi.org/10.3390/healthcare12020173> [Accessed 24 September 2024]

Alomair, R.A. & Pasha. S.A. 2024. An emperical Investigation into the impact of Electronic Health Records on Healthcare Quality and Patient Safety. *Open Access Public Health and Health Administration Review*, 2(2):30–38. [https://doi.org/10.59644/oaphhar.2\(2\).97](https://doi.org/10.59644/oaphhar.2(2).97) [Accessed 20 August 2024]

Alowais, S.A., Alghamdi, S.S., Alsuhebany, N., Alqahtani, T., Alshaya, A.I., Almohareb, S.N., Aldairem, A., Alrashed, M., Bin Saleh, K., Badreldin, H.A., Al Yami, M.S., Al Harbi, S. & Albekairy, A.M. 2023. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. *BMC Medical Education*, 23(1):689. <https://doi.org/10.1186/s12909-023-04698-z> [Accessed 12 June 2024]

Alrimali, A. & Alreshidi, N. 2024. An assessment of nurse-patient therapeutic communication and patient satisfaction with nursing care in multiple healthcare settings: A study in Saudi Arabia. *Journal of Nursing Education and Practice*, 14(2). <https://doi.org/10.5430/jnep.v14n2p15> [Accessed 15 July 2024]

Alshammari, S.H. 2024. The effects of technical skills, attitudes and knowledge on students' readiness to use 4.0 industrial revolution technologies in education. *International Journal of*

Education in Mathematics, Science and Technology (IJEMST), 12(1):40-52.

<https://doi.org/10.46328/ijemst.3638> [Accessed 15 July 2024]

Alshammari, A. & Fayez Alanazi, M. 2023. Use of Technology in Enhancing Learning Among Nurses in Saudi Arabia; a Systematic Review. *Journal of Multidisciplinary Healthcare*, 8(16):1587-1599. <https://doi:10.2147/JMDH.S413281> [Accessed 14 September 2023]

Alshammari, M.H. & Alenezi, A. 2023. Nursing workforce competencies and job satisfaction: the role of technology integration, self-efficacy, social support, and prior experience. *BMC Nursing*, 22(308). <https://doi.org/10.1186/s12912-023-01474-8> [Accessed 22 June 2024]

Altmiller, G. & Pepe, L. H. 2022. Influence of Technology in Supporting Quality and Safety in Nursing Education. *The Nursing clinics of North America*, 57(4):551–562.

<https://doi.org/10.1016/j.cnur.2022.06.005> [Accessed 5 September 2023]

Al Ahmari, R., Al Qannass, S., Govallen, P., Moorkan, N. & Homoud, Z. 2023. The Impact of Nurses Recognition, and Empowerment Related to Nurses Job Satisfaction at KFSH-D. *Open Journal of Nursing*, (13):81-94. <https://doi:10.4236/ojn/132006> [Accessed 22 May 2023]

AlAli, R. & Wardat, Y. 2024. Enhancing Classroom Learning: ChatGPT's Integration and Educational Challenges. *International Journal of Religion*, 5(6):971–985.

<https://doi.org/10.61707/znwnxd43> [Accessed 18 July 2024]

Al-Essa, L.A., Etman, W.B.H., Eliwa, M.S., El-Morshedy, M. & EL-Sagheer, R.M. 2024. A novel non-parametric statistical method in reliability theory: Mathematical characterization and analysis of asymmetric data in the fields of biological sciences and engineering. *Heliyon*, 10(13): E33596.

<https://doi.org/10.1016/j.heliyon.2024.e33596> [Accessed 20 July 2024]

Al-Hail, M., Zguir, M.F. & Koç, M. 2023. University students' and educators' perceptions on the use of digital and social media platforms: A sentiment analysis and a multi-country review.

iScience, 26(8):107322. <https://doi:10.1016/j.isci.2023.107322> [Accessed 14 September 2023]

Al-Hassan, M. & Al Omari, E. 2023. Simulation as a Tool for Continuous Professional Development Unveiling Excellence: Harnessing Simulation for Lifelong Learning in Nursing Practice. *Saudi Journal of Nursing and Healthcare*, 6(10):346-353.

<https://doi:10.36348/sjnhc.2023.v06i10.005> [Accessed 24 June 2024]

Al Kuwaiti, A., Nazer, K., Al-Reedy, A., Al-Shehri, S., Al-Muhanna, A., Subbarayalu, A.V., Al Muhanna, D. & Al-Muhanna, F.A. 2023. A Review of the Role of Artificial Intelligence in Healthcare. *Journal of Personalised Medicine*, 13(6):951. <https://doi:10.3390/jpm13060951>

[Accessed 10 June 2024]

Al Najjar, R.I. & Shafie, Z.M. 2022. “Impact of Nursing Informatics on the Quality of Patient Care”, *International Journal of Medical Science and Clinical Research Studies*, 2(5):418–421.

<https://doi.org/10.47191/ijmscrs/v2-i5-19> [Accessed 27 March 2023]

Al Shamsi, H., Almutairi, A.G., Al Mashrafi, S. & Al Kalbani, T. 2020. Implications of Language Barriers for Healthcare: A Systematic Review. *Oman Medical Journal*, 35(2): e122.

<https://doi:10.5001/omj.2020.40> [Accessed 13 June 2024]

Al-Subh, S.A. 2024. Chi-Square and EDF tests for student's T distribution using selective order statistics. *Mutah Journal for Natural, Applied and Health Sciences*, 39(1).

<https://doi.org/10.35682/mjnahs.v39i1.711> [Accessed 20 July 2024]

Amin, T. 2019. Inferential Statistics. <https://doi.org/10.13140/RG.2.2.26024.62725> [Accessed 24 March 2023]

Aminizadeh, S., Heidari, A., Dehghan, M., Toumaj, S., Rezaei, M., Navimipour, N.J., Stroppa, F. & Unal, M. 2024. Opportunities and challenges of artificial intelligence and distributed systems to improve the quality of healthcare service, *Artificial Intelligence in Medicine*, 149:102779. <https://doi.org/10.1016/j.artmed.2024.102779> [Accessed 18 July 2024]

Amjad, A., Kordel, P. & Fernandes, G. 2023. A Review on Innovation in the Healthcare Sector (Telehealth) through Artificial Intelligence. *Sustainability*, 15(8):6655. <https://doi.org/10.3390/su15086655> [Accessed 31 May 2023]

Anagnosti, A., Dourakis, A., Dimitra, D., Kefsenidi, S., Kanzoura, E., Delga, D., Douraki, E., Athanasia, B., Stamati, P., Gatanas, K. & Bilali, A. 2024. Does ChatGPT Improve the Nurse-Patient Relationship in Hospital? *International Journal of Clinical Studies & Medical Case Reports*, 37(5):001. <https://dx.doi.org/10.46998/IJCMCR.2024.37.000921> [Accessed 15 July 2024]

Anawade, P.A., Sharma, D. & Gahane, S. 2024. A Comprehensive Review on Exploring the Impact of Telemedicine on Healthcare Accessibility. *Cureus*, 16(3): e55996. <https://doi:10.7759/cureus.55996> [Accessed 20 July 2024]

Andolina, M.W. 2024. Youth, Generations, and Generational Research. *Political Science Quarterly*, 139(2):281–293. <https://doi.org/10.1093/psquar/qqad079> [Accessed 20 July 2024]

Andrade, C. 2018. Internal, External, and Ecological Validity in Research Design, Conduct, and Evaluation. *Indian Journal of Psychological Medicine*, 40(5):498. https://doi.org/10.4103/IJPSYM.IJPSYM_334_18 [Accessed 16 February 2023]

Anisha, S.A., Sen, A. & Bain, C. 2024. Evaluating the Potential and Pitfalls of AI-Powered Conversational Agents as Humanlike Virtual Health Carers in the Remote Management of Noncommunicable Diseases: Scoping Review. *Journal of Medical Internet Research*, 26: e56114. <https://doi:10.2196/56114> [Accessed 24 July 2024]

Antunes, V., Sousa, L. & Loureiro, F. 2021. Use of Digital Educational Technologies among Nursing Students and Teachers: An Exploratory Study. *Journal of Personalized Medicine*, 11. <https://doi.org.10.3390/jpm11101010> [Accessed 15 September 2022]

Anyango, E., Adama, E., Brown, J. & Ngune, I. 2024. The impact of final-year clinical placements on nursing students' career planning for the graduate year and beyond, *Nurse Education in Practice*, 76:103944. <https://doi.org/10.1016/j.nepr.2024.103944> [Accessed 15 July 2024]

Apell, P. & Eriksson, H. 2023. Artificial intelligence (AI) healthcare technology innovations: the current state and challenges from a life science industry perspective. *Technology Analysis & Strategic Management*, 35(2):179-193. <https://doi:10.1080/09537325.2021.1971188> [Accessed 16 September 2023]

Aranyossy, M. & Halmosi, P. 2024. Healthcare 4.0 value creation – The interconnectedness of hybrid value propositions. *Technological Forecasting and Social Change*, 208(123718). <https://doi.org/10.1016/j.techfore.2024.123718> [Accessed 24 September 2024]

- Archibald, M.M. & Barnard, A. 2018. Futurism in nursing: Technology, robotics and the fundamentals of care. *Journal of Clinical Nursing*, 27(11-12):2473-2480. <https://doi.org/10.1111/jocn.14081> [Accessed 1 June 2023]
- Arefin, S. 2024. AI Revolutionizing Healthcare: Innovations, Challenges, and Ethical Considerations. *MZ Journal of Artificial Intelligence*, 1(2):1-17. <http://mzjournal.com/index.php/MZJAI/article/view/193> [Accessed 24 July 2024]
- Arras-Djabi, M., Cottard, L. & Shimada, S. 2024. Understanding the stereotypes of Millennials in the workplace. *European Management Review*, 21(1):45-65. <https://doi.org/10.1111/emre.12559> [Accessed 15 July 2024]
- Arruum, D., Setyowati, H.H. & Artono, K.R. 2024. Nurses' Job Satisfaction Regarding the Use of Health Technology: A Survey Study. *Jurnal Keperawatan Indonesia*, 27(1):47-58. <https://doi.org/10.7454/jki.v27i1.1076> [14 August 2024]
- Aririguzoh, S. 2022. Communication competencies, culture and SDGs: effective processes to cross-cultural communication. *Humanities and Social Sciences Communications*, 9(96). <https://doi.org/10.1057/s41599-022-01109-4> [Accessed 10 June 2024]
- Ashipala, D. O., Sapalo, E. M. & Shikulo, P. I. 2024. Blended learning: Exploring nurse educators' perspectives. *Health SA Gesondheid* (Online), 29:1-8. <https://doi.org/10.4102/hsag.v29i0.2659> [Accessed 24 September 2024]
- Aslan, B. & Onal, O. 2024. Validity and Reliability of Four Instruments for E-Cigarette Dependence and Sensory Factors in E-Cigarette Use and Correlations Between These Measurements. *Journal of Drug Issues*, 0(0). <https://doi.org/10.1177/00220426241265629> [Accessed 20 July 2024]
- Aslani, S. & Jacob, J. 2023. Utilisation of deep learning for COVID-19 diagnosis. *Clinical Radiology*, 78(2):150-157. <https://doi.org/10.1016/j.crad.2022.11.006> [Accessed 17 September 2023]
- Asmawi, A. & Alam, M.S. 2024. Qualitative research: Understanding its underlying philosophies. *Forum for Education Studies*, 2(2):1320. <https://doi.org/10.59400/fes.v2i2.1320> [Accessed 18 July 2024]
- Aspers, P. & Corte, U. 2019. What is Qualitative in Qualitative Research. *Qualitative Sociology*, 42(2):139-160. <https://doi.org/10.1007/s11133-019-9413-7> [Accessed 1 June 2023]
- Aswin, A., Ariati, C. & Kurniawan, S. 2022. Artificial intelligence in higher education: a practical approach. *Journal of Higher Education Policy and Management*, 45:583-586. <https://doi.org/10.1080/1360080X.2022.2156088> [Accessed 16 September 2023]
- Ataro, B.A., Addisie, A., Hardido, T.G., Bolado, G.N., Bilate, D.S., Leka, Y.L. & Bezabih, B. 2024. Skill development practice-related challenges, and associated factors among nursing students. *BMC Nursing*, 23:429. <https://doi.org/10.1186/s12912-024-02115-4> [Accessed 15 July 2024]
- Attia Abdallah, Z., Abdel Rahman Khamis, E.M., Ibrahim, F.M. & Allah Wagdy Farag, A. 2024. Telenursing Future in Solving the Nursing Global Workforce Gap. *IntechOpen*, <https://doi.org/10.5772/intechopen.110745> [Accessed 14 August 2024]

Avinç, E. & Doğan, F. 2024. Digital literacy scale: Validity and reliability study with the Rasch model. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-024-12662-7> [Accessed 20 July 2024]

Ayabakan, S., Bardhan, I.R. & Zheng, Z. 2023. Impact of Telehealth and Process Virtualization on Healthcare Utilization. *Information Systems Research*, 35(1):45-65. <https://doi.org/10.1287/isre.2023.1220> [Accessed 20 August 2024]

Ayanwale, M.A. & Ndlovu, M. 2024. Investigating factors of students' behavioral intentions to adopt chatbot technologies in higher education: Perspective from expanded diffusion theory of innovation. *Computers in Human Behavior Reports*, 14:100396. <https://doi.org/10.1016/j.chbr.2024.100396> [Accessed 20 July 2024]

Ayers, J.W., Desai, N. & Smith, D.M. 2024. Regulate Artificial Intelligence in Health Care by Prioritizing Patient Outcomes. *Journal of the American Medical Association*, 331(8):639–640. <https://doi.org/10.1001/jama.2024.0549> [Accessed 14 August 2024]

Azher, S., Cervantes, A., Marchionni, C., Grewal, K., Marchand, H. & Harley, J.M. 2023. Virtual Simulation in Nursing Education: Headset Virtual Reality and Screen-based Virtual Simulation Offer a Comparable Experience. *Clinical Simulation in Nursing*, (79):61-74. <https://doi.org/10.1016/j.ecns.2023.02.009> [Accessed 31 May 2023]

Baako, I. & Abroampa, W.K. 2023. Research trends on ITC integration in Education: A bibliometric analysis. *Cogent Education*, 10(2). <https://doi.org/10.1080/2331186X.2023.2281162> [Accessed 8 January 2023]

Backåberg, S., Strandberg, S., Freeman, G., Katz, L., Rafiei Milajerdi, H., Wylant, B., Oehlberg, L. & Ekstedt, M. 2024. Facilitating co-design among older adults in a digital setting: methodological challenges and opportunities. *CoDesign*, 1–18. <https://doi.org/10.1080/15710882.2024.2372595> [Accessed 18 July 2024]

Badr, Y., Abdul Kader, L. & Shamayleh, A. 2024. The Use of Big Data in Personalized Healthcare to Reduce Inventory Waste and Optimize Patient Treatment. *Journal of Personalized Medicine*, 14(4):383. <https://doi.org/10.3390/jpm14040383> [Accessed 24 July 2024]

Bailey, S. 2023. How Technology Has Changed the Role of Nursing. <https://nursejournal.org/articles/technology-changing-nursing-roles/> [Accessed 17 September 2023]

Baillie, M., le Cessie, S., Schmidt, C.O., Lusa, L. & Huebner, M. 2022. Topic Group “Initial Data Analysis” of the STRATOS Initiative. Ten simple rules for initial data analysis. *PLoS Computational Biology*, 18(2): e1009819. <https://doi.org/10.1371/journal.pcbi.1009819> [Accessed 13 June 2024]

Bajwa, J., Munir, U., Nori, A. & Williams, B. 2021. Artificial intelligence in healthcare: transforming the practice of medicine. *Future Healthcare Journal*, 8(2): e188-e194. <https://doi.org/10.7861/fhj.2021-0095> [Accessed 17 September 2023]

Balalle, H. 2024. Exploring student engagement in technology-based education in relation to gamification, online/distance learning, and other factors: A systematic literature review, *Social Sciences & Humanities Open*, 9:100870. <https://doi.org/10.1016/j.ssaho.2024.100870> [Accessed 29 May 2024]

- Baldwin, J.R., Pingault, J.B., Schoeler, T, Sallis, H.M. & Munafo, M.R. 2022. Protecting against researcher bias in secondary data analysis: challenges and potential solutions. *European Journal of Epidemiology*, 37(1):1–10. <https://doi.org/10.1007/s10654-021-00839-0> [Accessed 15 February 2023]
- Balance, O.J. 2024. Sampling and randomisation in experimental and quasi-experimental CALL studies: Issues and recommendations for design, reporting, review, and interpretation. *ReCALL*, 36(1):58-71. <https://doi:10.1017/S0958344023000162> [Accessed 18 July 2024]
- Balwanth, S. & Singh, S. 2023. Oral healthcare provision at long-term care facilities in eThekweni: Perspectives of coordinators. *African Journal of Primary Health Care & Family Medicine*, 15(1):1-10. <https://dx.doi.org/10.4102/phcfm.v15i1.3884> [Accessed 15 September 2023]
- Bamel, U., Talwar, S., Pereira, V., Corazza, L. & Dhir, A. 2023. Disruptive digital innovations in healthcare: Knowing the past and anticipating the future. *Technovation*, (125):102785. <https://doi.org/10.1016/j.technovation.2023.102785> [Accessed 5 September 2023]
- Bangun, A. V. & Pragholapati, A. 2021. Enhancing Critical Thinking Skills in Nursing Higher Education in Preparation for the Industrial Revolution 4.0. *KnE Life Sciences*, 6(1):793-804. <https://doi.org/10.18502/cls.v6i1.8756> [Accessed 14 September 2023]
- Banskota, B., Bhusal, R., Bhattarai, N., Gurung, Y.P., Kumar Yadav, P. & Kumar Banskota, A. 2024. Health-related quality of life among lower limb amputees using prostheses in Nepal: a cross-sectional study. *BMC Sports Science, Medicine and Rehabilitation*, 16(220). <https://doi.org/10.1186/s13102-024-01008-y> [Accessed 24 September 2024]
- Barchielli, C., Marullo, C., Bonciani, M. & Vainieri, M. 2021. Nurses and the acceptance of innovations in technology-intensive contexts: the need for tailored management strategies. *BMC Health Services Research*, 21(1):639. <https://doi.org/10.1186/s12913-021-06628-5> [Accessed 28 March 2023]
- Barker, T., Habibi, N., Aromataris, E., Stone, J., Leonardi-Bee, J., Sears, K., Hasanoff, S., Klugar, M., Tufanaru, C., Moola, S. & Munn, Z. 2024. The revised JBI critical appraisal tool for the assessment of risk of bias for quasi-experimental studies. *JBI Evidence Synthesis*, 22(3):378-388. <https://doi:10.11124/JBIES-23-00268> [Accessed 20 July 2024]
- Barroga, E. & Matanguihan, G.J. 2022. A Practical Guide to Writing Quantitative and Qualitative Research Questions and Hypotheses in Scholarly Articles. *Journal of Korean Medical Science*, 37(16): e121. <https://doi:10.3346/jkms.2022.37.e121> [Accessed 17 September 2023]
- Barrow, J.M., Brannan, G.D. & Khandhar, P.B. Research Ethics. 2022. Research Ethics. StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK459281/> [Accessed 27 March 2023]
- Basheer, N., Ahmed, V., Bahroun, Z. & Anane, C. 2024. Exploring Sustainability Assessment Practices in Higher Education: A Comprehensive Review through Content and Bibliometric Analyses. *Sustainability*, 16(13):5799. <https://doi.org/10.3390/su16135799> [Accessed 18 July 2024]
- Batholmeus, P. & Pop, C. 2021. Enablers of work-integrated learning in technical vocational education and training teacher education. *International Journal of Work-Integrated Learning*, 20(2):147-159. <https://eric.ed.gov/?id=EJ1226181> [Accessed 4 September 2023]

- Bayuo, J. 2024. Revisiting the philosophy of technology and nursing: Time to move beyond romancing resistance or resisting romance. *Nursing Philosophy*, 25: e12503. <https://doi.org/10.1111/nup.12503> [Accessed 24 September 2024]
- Bazargani, K. & Deemyad, T. 2024. Automation's Impact on Agriculture: Opportunities, Challenges, and Economic Effects. *Robotics*, 13(2):33. <https://doi.org/10.3390/robotics13020033> [Accessed 10 July 2024]
- Becking-Verhaar, F.L., Verweij, R.P.H., de Vries, M., Vermeulen, H., van Goor, H. & Huisman-de Waal, G.J. 2023. Continuous Vital Signs Monitoring with a Wireless Device on a General Ward: A Survey to Explore Nurses' Experiences in a Post-Implementation Period. *International Journal of Environmental Research and Public Health*, 20(10):5794. <https://doi.org/10.3390/ijerph20105794> [Accessed 20 July 2024]
- Begkos, C., Antonopoulou, K. & Ronzani, M. 2024. To datafication and beyond: Digital transformation and accounting technologies in the healthcare sector. *The British Accounting Review*, 56(4):101259. <https://doi.org/10.1016/j.bar.2023.101259> [Accessed 14 July 2024]
- Bekbolatova, M., Mayer, J., Ong, C.W. & Toma, M. 2024. Transformative Potential of AI in Healthcare: Definitions, Applications, and Navigating the Ethical Landscape and Public Perspectives. *Healthcare*. 2024; 12(2):125. <https://doi.org/10.3390/healthcare12020125> [Accessed 14 July 2024]
- Bell, S.M., Chalmers, R.P. & Flora, D.B. 2024. The Impact of Measurement Model Misspecification on Coefficient Omega Estimates of Composite Reliability. *Educational and Psychological Measurement*, 84(1):5-39. <https://doi.org/10.1177/00131644231155804> [Accessed 10 July 2024]
- Bello, S. 2024. "Legacies of Freedom: Tracing Theories of Freedom into the Contemporary Conversation on International Intervention". Senior Theses, Trinity College, Hartford, CT 2024. Trinity College Digital Repository. <https://digitalrepository.trincoll.edu/theses/1101> [Accessed 18 July 2024]
- Bentum-Micah, G., Cai, L., Atuahene, S.A., Ameyaw, M.A., Bondzie-Micah, V. & Adu-Yeboah, S.S. 2024. Health provider administration functions, patient satisfaction, and loyalty: Their mediation by patient healthcare service quality perceptions. *Journal of Psychology in Africa*, 34(1):65–72. <https://doi.org/10.1080/14330237.2024.2314365> [Accessed 15 July 2024]
- Beres, L.K., Underwood, A., Le Tourneau, N., Galloway Kemp, C., Kore, G., Yaeger, L., Li, J., Aaron, A., Keene, C., Mallela, D.P., Khalifa, B.A.A., Mody, A., Schwartz, S.R., Baral, S., Mwamba, C., Sikombe, K., Eshun-Wilson, I., Geng, E.H. & Lavoie, M-C.C. 2024. Person-centered interventions to improve patient–provider relationships for HIV services in low- and middle-income countries: a systematic review. *Journal of the International AIDS Society*, 27: e26258. <https://doi.org/10.1002/jia2.26258> [Accessed 14 July 2024]
- Berardi, C., Antonini, M., Jordan, Z., Wechtler, H., Paolucci, F. & Hinwood, M. 2024. Barriers and facilitators to the implementation of digital technologies in mental health systems: a qualitative systematic review to inform a policy framework. *BMC Health Services Research*, 24(243). <https://doi.org/10.1186/s12913-023-10536-1> [Accessed 22 September 2024]

Berg, J., Green, F., Nurski, L. & Spencer, D. A. 2023. Risks to job quality from digital technologies: Are industrial relations in Europe ready for the challenge? *European Journal of Industrial Relations*, 29(4):347-365. <https://doi.org/10.1177/09596801231178904> [Accessed 22 June 2024]

Bergen, N. & Labonté, R. 2020. "Everything Is Perfect, and We Have No Problems": Detecting and Limiting Social Desirability Bias in Qualitative Research. *Qualitative Health Research*, 30(5):783-792. <https://doi:10.1177/1049732319889354> [Accessed 25 May 2023]

Bermejo, B., Juiz, C., Cortes, D., Oskam, J., Moilanen, T., Loijas, J., Govender, P., Hussey, J., Schmidt, A.L., Burbach, R., King, D., O'Connor, C. & Dunlea, D. 2023. AR/VR Teaching-Learning Experiences in Higher Education Institutions (HEI): A Systematic Literature Review. *Informatics*, 10(2):45. <https://doi.org/10.3390/informatics10020045> [Accessed 20 September 2024]

Bester, P., Smit, K., De Beer, M. & Myburgh, P.H. 2021. 'When online learning becomes compulsory: Student nurses' adoption of information communication technology in a private nursing education institution'. *Curationis*, 44(1): a2152. <https://doi.org/10.4102/curationis.v44i1.2152> [Accessed 14 September 2023]

Bhandari, P. 2022a. What Is Quantitative Research? | Definition, Uses & Methods. Scribbr. <https://www.scribbr.com/methodology/quantitative-research/> [Accessed 13 February 2023]

Bhandari, P. 2022b. Levels of Measurement | Nominal, Ordinal, Interval and Ratio. Scribbr. <https://www.scribbr.com/statistics/levels-of-measurement/> [Accessed 15 February 2023]

Bhandari, P. & Nikolopoulou, K. 2023. What Is a Likert Scale? | Guide & Examples. Scribbr. <https://www.scribbr.com/methodology/likert-scale/> [Accessed 15 February 2023]

Bhandari, P. 2023a. Descriptive Statistics | Definitions, Types, Examples. Scribbr. <https://www.scribbr.com/statistics/descriptive-statistics/> [Accessed 15 February 2023]

Bhandari, P. 2023b. How to Calculate Standard Deviation (Guide) | Calculator & Examples. Scribbr. <https://www.scribbr.com/statistics/standard-deviation/> [Accessed 3 April 2023]

Bhandari, P. 2023c. Central Tendency | Understanding the Mean, Median & Mode. Scribbr. <https://www.scribbr.com/statistics/central-tendency/> [Accessed 13 August 2023]

Bhandari, P. 2023d. Inferential Statistics | An Easy Introduction & Examples. Scribbr. <https://www.scribbr.com/statistics/inferential-statistics/> [Accessed 4 September 2023]

Bhardwaj, A. & Kumar, V. 2024. Challenges in online collaboration to augment Industry 4.0. *International Journal of Technology, Policy and Management*, 24(1). <http://dx.doi.org/10.1504/IJTPM.2024.10055992> [Accessed 18 July 2024]

Bhaskar, P. & Rana, S. 2024. The ChatGPT dilemma: unravelling teachers' perspectives on inhibiting and motivating factors for adoption of ChatGPT. *Journal of Information, Communication and Ethics in Society*, 22(2):219-239. <https://doi:10.1108/JICES-11-2023-0139> [Accessed 15 July 2024]

Bhatia, R. 2021. Emerging Health Technologies and How They Can Transform Healthcare Delivery. *Journal of Health Management*, 23(1):63-73. <https://doi:10.1177/0972063421995025> [Accessed 21 June 2024]

Billings, J., Ching, B.C.F., Gkofa, V., Greene, T. & Bloomfield, M. 2021. Experiences of frontline healthcare workers and their views about support during COVID-19 and previous pandemics: a

systematic review and qualitative meta-synthesis. *BMC Health Services Research*, 21(1):923. <https://doi.org/10.1186/s12913-021-06917-z> [Accessed 17 September 2023]

Bläsius, T. & Fischbeck, P. 2024. On the External Validity of Average-case Analyses of Graph Algorithms. *ACM Transactions on Algorithms*, 20(1):1–42. <https://doi.org/10.1145/3633778> [Accessed 20 July 2024]

Bøe, S.V & Debesay, J. 2021. The Learning Environment of Student Nurses During Clinical Placement: A Qualitative Case Study of a Student-Dense Ward. *SAGE Open Nursing*, (7):23779608211052357. <https://doi:10.1177/23779608211052357> [Accessed 2 April 2023]

Bogiannidis, N., Southcott, J. & Gindidis, M. 2023. An exploration of the possible educational opportunities and the challenges at the intersection of the physical and digital worlds occupied by 10–14-year-old students. *Smart Learning Environments*, (10):26. <https://doi.org/10.1186/s40561-023-00246-w> [Accessed 30 August 2023]

Bonache, J. & Festing, M. 2020. Research paradigms in international human resource management: An epistemological systematization of the field. *German Journal of Human Resource Management*, 34(2):99-123. <https://doi.org/10.1177/2397002220909780> [Accessed 4 August 2023]

Boniol, M., Kunjumen, T., Nair, T.S., Siyam, A., Campbell, J. & Diallo, K. 2022. The global health workforce stock and distribution in 2020 and 2030: a threat to equity and 'universal' health coverage? *BMJ Global Health*, 7(6): e009316. <https://doi:10.1136/bmjgh-2022-009316> [Accessed 14 June 2024]

Bonnamy, J., Levett-Jones, T., Carr, B., Lokmic-Tomkins, Z., Maguire, J., Catling, C., Pich, J., Fields, L. & Brand, G. 2024. Australian and New Zealand nursing and midwifery educators' planetary health knowledge, views, confidence and teaching practices: A descriptive survey study. *Journal of Advanced Nursing*, 00:1–12. <https://doi.org/10.1111/jan.16317> [Accessed 18 July 2024]

Booth, R.G., Strudwick, G., McBride, S., O'Connor, S. & Solano Lopez, A.L. 2021a. How the nursing profession should adapt for a digital future. *British Medical Journal*, 373:1190. <https://doi.org/doi:10.1136/bmj.n1190> [Accessed 2 April 2023]

Booth, R.G., Strudwick, G., McMurray, J., Chan, R., Cotton, K. & Cooke, S. 2021b. The Future of Nursing Informatics in a Digitally Enabled World. *Introduction to Nursing Informatics*, 395-417. https://doi.org/10.1007/978-3-030-58740-6_16 [Accessed 28 March 2023]

Borges do Nascimento, I.J., Abdulazeem, H., Vasanthan, L.T., Martinez, E.Z., Zucoloto, M.L., Østengaard, L., Azzopardi-Muscat, N., Zapata, T. & Novillo-Ortiz, D. 2023. Barriers and facilitators to utilizing digital health technologies by healthcare professionals. *NPJ Digital Medicine*, 6(1):161. <https://doi:10.1038/s41746-023-00899-4> [Accessed 24 July 2024]

Bouhouita-Guermech, S., Gogognon, P. & Bélisle-Pipon, J.C. 2023. Specific challenges posed by artificial intelligence in research ethics. *Frontiers in Artificial Intelligence*, 6:1149082. <https://doi:10.3389/frai.2023.1149082> [Accessed 16 October 2023]

Bos, J. 2020. Research Ethics Step by Step. In: *Research Ethics for Students in Social Sciences*. Springer. Cham. https://doi.org/10.1007/978-3-030-48415-6_10 [Accessed 28 May 2023]

- Bowles, T., Trentino, K.M., Lloyd, A., Trentino, L., Murray, K., Thompson, A., Sanfilippo, F.M. & Waterer, G. 2024. Health in a Virtual Environment (HIVE): A Novel Continuous Remote Monitoring Service for Inpatient Management. *Healthcare*, 12(13):1265. <https://doi.org/10.3390/healthcare12131265> [Accessed 24 July 2024]
- Bramhe, S. & Pathak, S.S. 2022. Robotic Surgery: A Narrative Review. *Cureus*, 14(9): e29179. <https://doi:10.7759/cureus.29179> [Accessed 5 June 2023]
- Brandt, L., Liu, S., Heim, C. & Heinz, A. 2022. The effects of social isolation stress and discrimination on mental health. *Translational Psychiatry*, 12(1):398. <https://doi:10.1038/s41398-022-02178-4> [Accessed 13 June 2024]
- Brito, M. 2023. The Top 5 Gen Alpha Characteristics Every Marketer Should Know. <https://www.britopian.com/data/gen-alpha-characteristics/> [Accessed 10 June 2024]
- Broer, N., Walt, van der Walt, J., Wolhuter, C., Mollo, N. & Mampane, K. 2024. South African Parents' Perspectives on Learner Discipline. *International Journal of Advanced Academic Research*, 10(6):11-25. <https://www.openjournals.ijaar.org/index.php/ijaar/article/view/612> [Accessed 20 July 2024]
- Brown, J., Pope, N., Maria, A., Mason, J. & Morgan, A. 2020. Issues affecting nurses' capability to use digital technology at work: An integrative review. *Journal of Clinical Nursing*, 29. <https://doi:10.1111/jocn.15321> [Accessed 24 July 2024]
- Brunette, C. 2023. Adaptive Intelligence Learning Architecture Data Set. figshare. Dataset. <https://doi.org/10.6084/m9.figshare.23884254.v1> [Accessed 11 July 2023]
- Buabeng-Andoh, C. 2018. New Technology in Health Education: Nursing Students' Application of Mobile Technology in the Classroom in Ghana. *Interactive Technology and Smart Education*, 15(1):46-58. [Accessed 9 October 2021]
- Bucci, S., Schwannauer, M. & Berry, N. 2019. The digital revolution and its impact on mental healthcare. *Psychology and psychotherapy*, 92(2):277–297. <https://doi.org/10.1111/papt.12222> [Accessed 28 March 2023]
- Bujang, M.A., Omar, E.D. & Baharum, N.A. 2018. A Review on Sample Size Determination for Cronbach's Alpha Test: A Simple Guide for Researchers. *Malaysian Journal of Medical Sciences*, 25(6):85-99. <https://doi:10.21315/mjms2018.25.6.9> [Accessed 9 October 2021]
- Buller, L., Hodo, A. & Williams, K. 2024. Technology driven by artificial intelligence advances professional growth and development. *Nursing Management* (Springhouse), 55(3):30-38. <https://doi:10.1097/nmg.000000000000110> [Accessed 10 July 2024]
- Burgess, T., Rennie, S. & Moodley, K. 2023. Key ethical issues encountered during COVID-19 research: a thematic analysis of perspectives from South African research ethics committees. *BMC Medical Ethics*, 24(1):11. <https://doi.org/10.1186/s12910-023-00888-y> [Accessed 15 September 2023]
- Burgess, J.M. & Honey, M. 2022. Nurse Leaders Enabling Nurses to Adopt Digital Health: Results of an Integrative Literature Review. *Nursing Praxis in Aotearoa New Zealand*, 38(3). <https://doi.org/10.36951/001c.40333> [Accessed 22 June 2024]

Busetto, L., Wick, W. & Gumbinger, C. 2020. How to use and assess qualitative research methods. *Neurological Research and Practice*, 27(2):14. <https://doi.org/10.1186/s42466-020-00059-z> [Accessed 1 June 2023]

Busse, T.S., Nitsche, J., Kernebeck, S., Jux, C., Weitz, J., Ehlers, J.P. & Bork, U. 2022. Approaches to Improvement of Digital Health Literacy (eHL) in the Context of Person-Centered Care. *International Journal of Environmental Research and Public Health*, 19(14):8309. <https://doi.org/10.3390/ijerph19148309> [Accessed 21 June 2024]

Butcher, C.J. & Hussain, W. 2022. Digital healthcare: the future. *Future Healthcare Journal*, 9(2):113-117. <https://doi.org/10.7861/fhj.2022-0046> [Accessed 21 June 2024]

Cabero-Almenara, J., De-La-Portilla-De-Juan, F., Barroso-Osuna, J. & Palacios-Rodríguez, A. 2023. Technology-Enhanced Learning in Health Sciences: Improving the Motivation and Performance of Medical Students with Immersive Reality. *Applied Sciences*, 13(14):8420. <https://doi.org/10.3390/app13148420> [Accessed 22 September 2024]

Cachata, D., Costa, M., Magalhães, T. & Gaspar, F. 2024. The Integration of Information Technology in the Management and Organization of Nursing Care in a Hospital Environment: A Scoping Review. *International Journal of Environmental Research and Public Health*, 21(8):968. <https://doi.org/10.3390/ijerph21080968> [Accessed 24 September 2024]

Cadorete, J.H., McCurry, M.K., Letourneau, R.M. & Viveiros, J.D. 2024. Competence and Confidence with Quality and Safety Education for Nurses Competencies by Newly Licensed Registered Nurses. *Journal for Nurses in Professional Development*, 40(3):133-138. <https://doi.org/10.1097/NND.0000000000001045> [Accessed 15 July 2024]

Cahusac, P.M.B. 2024. Likelihood Ratio Test and the Evidential Approach for 2×2 Tables. *Entropy*, 26(5):375. <https://doi.org/10.3390/e26050375> [Accessed 20 July 2024]

Califf, R.M. 2018. Future of personalized cardiovascular medicine: JACC state-of-the-art review. *Journal of the American College of Cardiology*, 72(25):3301-3309. <https://doi.org/10.1016/j.jacc.2018.09.079> [Accessed 14 August 2021]

Callaghan, C. 2023. Revisiting how scientific research drives technological change: The Fifth Industrial Revolution. *South African Journal of Science*, 119:7-8. <https://doi.org/10.17159/sajs.2023/15556> [Accessed 19 September 2023]

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D. & Walker, K. 2020. Purposive sampling: complex or simple? Research case examples. *Journal of Research in Nursing*, 25(8):652-661. <https://doi.org/10.1177/1744987120927206> [Accessed 13 June 2024]

Canziani, B. & MacSween, S. 2021. Consumer acceptance of voice-activated smart home devices for product information seeking and online ordering. *Computers in Human Behavior*, 119:106714. <https://doi.org/10.1016/j.chb.2021.106714> [Accessed 5 June 2023]

Capili, B. 2021. Selection of the Study Participants. *American Journal of Nursing*, 121(1):64-67. <https://doi.org/10.1097/01.NAJ.0000731688.58731.05> [Accessed 31 May 2023]

Capriulo, M., Pizzolla, I. & Briganti, G. 2024. Chapter 3 - On the use of patient-reported measures in digital medicine to increase healthcare resilience, Editor(s): Patricia Ordóñez De Pablos, Xi Zhang, In Information Technologies in Healthcare Industry, Artificial Intelligence, Big Data,

Blockchain and 5G for the Digital Transformation of the Healthcare Industry. *Academic Press*, 41-66. <https://doi.org/10.1016/B978-0-443-21598-8.00019-1> [Accessed 14 August 2024]

Carayannis, E.G., Posselt, T. & Preissler, S. 2024. Toward Industry 6.0 and Society 6.0: The Quintuple Innovation Helix with Embedded AI Modalities as Enabler of Public Interest Technologies Strategic Technology Management and Road-Mapping. *IEEE Transactions on Engineering Management*, 71:11238-11252. <https://doi:10.1109/TEM.2024.3406427> [Accessed 14 July 2024]

Cary, M.P., De Gagne, J.C., Kauschinger, E.D. & Carter, B.M. 2024. Advancing Health Equity Through Artificial Intelligence: An Educational Framework for Preparing Nurses in Clinical Practice and Research. *Creative Nursing*, 30(2):154-164. <https://doi:10.1177/10784535241249193> [Accessed 24 June 2024]

Cartwright, M. 2023. The Steam Engine in the British Industrial Revolution. World History Encyclopedia. Retrieved from <https://www.worldhistory.org/article/2166/the-steam-engine-in-the-british-industrial-revolution/> [Accessed 12 September 2023]

Cash, P., Isaksson, O., Maier, A. & Summers, J. 2022. Sampling in design research: Eight key considerations. *Design Studies*, 78:101077. <https://doi.org/10.1016/j.destud.2021.101077> [Accessed 4 September 2023]

Castonguay, A., Farthing, P., Davies, S., Vogelsang, L., Kleib, M., Risling, T. & Green, N. 2023. Revolutionizing nursing education through AI integration: A reflection on the disruptive impact of ChatGPT. *Nurse Education Today*, 129:105916. <https://doi.org/10.1016/j.nedt.2023.105916> [Accessed 15 July 2024]

Castillo, W. & Babb, N. 2023. Transforming the future of quantitative educational research: a systematic review of enacting quantCrit. *Race Ethnicity and Education*, 27(1):1–21. <https://doi.org/10.1080/13613324.2023.2248911> [Accessed 15 July 2024]

Casula, M., Rangarajan, N. & Shields, P. 2021. The potential of working hypotheses for deductive exploratory research. *Quality & Quantity*, 55(5):1703-1725. <https://doi.org/10.1007/s11135-020-01072-9> [Accessed 31 May 2023]

Caulfield, J. 2022. How to Do Thematic Analysis | Step-by-Step Guide & Examples. Scribbr. <https://www.scribbr.com/methodology/thematic-analysis/> [Accessed 23 May 2022]

Cè, M., Chiarpenello, V., Bubba, A., Felisaz, P.F., Oliva, G., Irmici, G. & Cellina, M. 2024. Exploring the Role of ChatGPT in Oncology: Providing Information and Support for Cancer Patients. *BioMedInformatics*, 4(2):877-888. <https://doi.org/10.3390/biomedinformatics4020049> [Accessed 18 July 2024]

Celhay, P., Meyer, B.D. & Mittag, N. 2024. What leads to measurement errors? Evidence from reports of program participation in three surveys. *Journal of Econometrics*, 238(2):105581. <https://doi.org/10.1016/j.jeconom.2023.105581> [Accessed 20 July 2024]

Chafe, R. 2023. Rejecting Choices: The Problematic Origins of Researcher-Defined Paradigms within Qualitative Research. *International Journal of Qualitative Methods*, 22. <https://doi.org/10.1177/16094069231165951> [Accessed 15 September 2023]

- Chaharsoughi, N.T., Ahmadifaraz, M. & Kahangi, L.S. 2022. The impact of digital technologies in nursing care and their application: A narrative review. *Journal of Multidisciplinary Care*, 11(3):149-156. <https://doi:10.34172/jmdc.2022.1127> [Accessed 22 June 2024]
- Chakraborty, C., Pal, S., Bhattacharya, M., Dash, S. & Lee, S.S. 2023. Overview of Chatbots with special emphasis on artificial intelligence enabled ChatGPT in medical science. *Frontiers in Artificial Intelligence*, 6:1237704. <https://doi:10.3389/frai.2023.1237704> [Accessed 10 June 2024]
- Chalmers, D., MacKenzie, N.G. & Carter, S. 2021. Artificial Intelligence and Entrepreneurship: Implications for Venture Creation in the Fourth Industrial Revolution. *Entrepreneurship Theory and Practice*, 45(5):1028–1053. <https://doi.org/10.1177/1042258720934581> [Accessed 190 September 2023]
- Chan, N. 2023. Generation Alpha Characteristics That Marketers Need to Know. <https://www.spiralytics.com/blog/generation-alpha-characteristics/> [Accessed 14 September 2023]
- Chance, B., McGaughey, K., Chung, S., Goodman, A., Roy, S. & Tintle, N. 2024. Simulation-Based Inference: Random Sampling vs. Random Assignment? What Instructors Should Know. *Journal of Statistics and Data Science Education*, 1–10. <https://doi.org/10.1080/26939169.2024.2333736> [Accessed 202 July 2024]
- Chang, H., Liu, B., Zhao, Y., Li, Y. & He, F. 2024. Research on the acceptance of ChatGPT among different college student groups based on latent class analysis. *Interactive Learning Environments*, 1-17. <https://doi:10.1080/10494820.2024.2331646> [Accessed 13 September 2024]
- Chang, C.Y., Yang, C.L., Jen, H.J., Ogata, H. & Hwang, G.H. 2024. Facilitating nursing and health education by incorporating ChatGPT into learning designs. *Educational Technology & Society*, 27(1):215–230. <https://www.jstor.org/stable/48754852> [Accessed 15 July 2024]
- Chang, V., Ansari, Y. & Arami, M. 2024. ChatGPT in Higher Education: A Risk Management Approach to Academic Integrity, Critical Thinking, and Workforce Readiness. *Proceedings of the 6th International Conference on Finance, Economics, Management and IT Business*, 79-85. <https://doi:10.5220/0012764100003717> [Accessed 18 July 2024]
- Chang, H.E. & Cho, S.H. 2022. Nurses' steps, distance traveled, and perceived physical demands in a three-shift schedule. *Human Resources for Health*, 20:72. <https://doi.org/10.1186/s12960-022-00768-3> [Accessed 15 November 2023]
- Charlly, N. & Swedlund, M. 2024. Can You Hear Me Now? Patient Perceptions of Telehealth in a Rural Primary Care Population. *Telemedicine and e-Health*, 30(6): e1719-e1726. <https://doi.org/10.1089/tmj.2023.0554> [Accessed 10 July 2024]
- ChatGPT. 2022. An API for accessing new AI models developed by OpenAI. <https://platform.openai.com> [Accessed 16 October 2023]
- Chatterjee, J. & Dsilva, N.R. 2021. "A study on the role of social media in promoting sustainable tourism in the states of Assam and Odisha". *Tourism Critiques*, 2(1):74-90. <https://doi.org/10.1108/TRC-09-2020-0017> [Accessed 16 August 2023]

Chaturvedi, A. 2025. OpenAI "Deep Research" in ChatGPT: A Game-Changer for Complex Problem Solving? <https://elephas.app/blog/openai-deep-research-in-chatgpt-a-game-changer-for-complex-problem-solving-cm6ry2zr30042rqzdmamgrz7s> [Accessed 13 March 2025]

Chee, S.Y. 2023. Age-related digital disparities, functional limitations, and social isolation: unraveling the grey digital divide between baby boomers and the silent generation in senior living facilities. *Aging & Mental Health*, 28(4):621–632. <https://doi.org/10.1080/13607863.2023.2233454> [Accessed 24 July 2024]

Chen, P.J. & Liou, W.K. 2024. Development and Application of Intuitive 3D Digital Global Health Information Teaching System in Nursing Education. *Biomedical Science and Clinical Research*, 3(1):01-06. [Accessed 18 July 2024]

Chen, X., Huang, B. & Lin, W. 2023. The effect of interpersonal relationships and epidemic attention on negative emotion among medical students: the mediating role of social satisfaction. *BMC Psychiatry*, 23(1):610. <https://doi:10.1186/s12888-023-05113-z> [Accessed 10 October 2023]

Chen, C., Ding, S. & Wang, J. 2023. Digital health for aging populations. *Nature Medicine*, 29(7):1623–1630. <https://doi.org/10.1038/s41591-023-02391-8> [Accessed 17 September 2023]

Chen, S., Kilobits, M., Devine, M & Stark, S. 2022. Sociodemographic Differences in Respondent Preferences for Survey Formats: Sampling Bias and Potential Threats to External Validity. *Archives of Rehabilitation Research and Clinical Translation*, 4(1):2590-1095. <https://doi.org/10.1016/j.arrct.2021.100175> [Accessed 9 March 2023]

Chen, C., Loh, E.W., Kuo, K.N. & Tam, K.W. 2019. The Times they Are a-Changin' - Healthcare 4.0 Is Coming! *Journal of Medical Systems*, 44(2):40. <https://doi:10.1007/s10916-019-1513-0> [Accessed 15 September 2023]

Cheraghi, R., Ebrahimi, H., Kheibar, N. & Sahebihagh, M.H. 2023. Reasons for resistance to change in nursing: an integrative review. *BMC Nursing*, 22(1):310. <https://doi:10.1186/s12912-023-01460-0> [Accessed 20 September 2024]

Cheraghi, R., Valizadeh, L., Zamanzadeh, V., Hassankhani, H. & Jafarzadeh, A. 2023. Clarification of ethical principle of the beneficence in nursing care: an integrative review. *BMC Nursing*, 22(1):89. <https://doi:10.1186/s12912-023-01246-4> [Accessed 29 May 2023]

Chereka, A.A., Demsash, A.W., Ngusie, H.S. & Kassie, S.Y. 2022. Digital health literacy to share COVID-19 related information and associated factors among healthcare providers worked at COVID-19 treatment centers in Amhara region, Ethiopia: A cross-sectional survey. *Informatics in Medicine Unlocked*, 30:100934. <https://doi.org/10.1016/j.imu.2022.100934> [Accessed 17 September 2023]

Cheung, G.W., Cooper-Thomas, H.D., Lau, R.S. & Wang, L.C. 2023. Reporting reliability, convergent and discriminant validity with structural equation modeling: A review and best-practice recommendations. *Asia Pacific Journal of Management*. <https://doi.org/10.1007/s10490-023-09871-y> [Accessed 16 August 2023]

Chichirez, C. & Purcărea, V. 2018. Interpersonal communication in healthcare. *Journal of Medicine and Life*, 11(2):119- 122. <https://doi:10.5281/zenodo.5790211> [Accessed 23 September 2023]

- Chigbu, U.E., Atiku, S.O. & Du Plessis, C.C. 2023. The Science of Literature Reviews: Searching, Identifying, Selecting, and Synthesising. *Publications*, 11(1):2. <https://doi.org/10.3390/publications11010002> [Accessed 15 September 2023]
- Chimezie, R. 2023. Health Awareness: A Significant Factor in Chronic Diseases Prevention and Access to Care. *Journal of Biosciences and Medicines*, 11:64-79. <https://doi.org/10.4236/jbm.2023.112005> [Accessed 24 July 2024]
- Chingwali-Nsanta, S., Buys, H., Burman, R. J. & Wilmhurst, J. M. 2023. Forthcoming Issue 1 2024: Demographic and aetiological factors of paediatric status epilepticus: a South African retrospective observational study. *South African Journal of Child Health*, 18(1): e2019. <https://samajournals.co.za/index.php/sajch/article/view/1448> [Accessed 17 September 2023]
- Chinnakali, P. & Kumar, S.S. 2024. Chapter 14 - Effective use of information technology for the quality of public health practice. Editor(s): Soundappan Kathirvel, Amarjeet Singh, Arun Chockalingam. Principles and Application of Evidence-based Public Health Practice. *Academic Press*, 239-257, <https://doi.org/10.1016/B978-0-323-95356-6.00014-8> [Accessed 10 July 2024]
- Chippis, J., le Roux, L., Agabus, J. & Bimerew, M. 2022. Nursing informatics skills relevance and competence for final year nursing students. *Curationis*, 45(1):1-8. <https://dx.doi.org/10.4102/curationis.v45i1.2277> [Accessed 14 September 2023]
- Chiu, T.K.F. 2024. Future research recommendations for transforming higher education with generative AI, Computers and Education: *Artificial Intelligence*, 6:100197. <https://doi.org/10.1016/j.caeai.2023.100197> [Accessed 10 July 2024]
- Choi, M., Lee, H. & Park, J.H. 2018. Effects of using mobile device-based academic electronic medical records for clinical practicum by undergraduate nursing students: a quasi-experimental study. *Nursing Education Today*, 61:112-119. <https://doi.org/10.1016/j.nedt.2017.11.018> [Accessed 2 August 2021]
- Choudhury, A., Elkefi, S. & Tounsi, A. 2024. Exploring factors influencing user perspective of ChatGPT as a technology that assists in healthcare decision making: A cross-sectional survey study. *PLoS ONE*, 19(3): e0296151. <https://doi.org/10.1371/journal.pone.0296151> [Accessed 15 July 2024]
- Chourasia, S., Tyagi, A., Pandey, S.M., Walia, R.S. & Murtaza, Q. 2022. Sustainability of Industry 6.0 in Global Perspective: Benefits and Challenges. *MAPAN*, 37:443–452. <https://doi.org/10.1007/s12647-022-00541-w> [Accessed 16 July 2024]
- Christofi, M., Hadjielias, E., Hughes, M. & Plakoyiannaki, E. 2024. Advancing Research Methodologies in Management: Revisiting Debates, Setting New Grounds for Pluralism. *British Journal of Management*, 35: 24-35. <https://doi.org/10.1111/1467-8551.12791> [Accessed 18 July 2024]
- Chua, S.H., Rajasegeran, D.D., Gunasegaran, N., Fan, P.E.M., Dong, M., Oo, F.A., Nagalingam, S., Lee, T.T., Ng, L.J.K., Yong, S.L.B., Zhen Ng, Y., Ang, S.Y. & Aloweni, F. 2024. Use of a mobile application to monitor drain sites and surgical wounds after discharge from acute care - A feasibility study in Singapore. *Journal of Tissue Viability*, 00(00). <https://doi.org/10.1016/j.jtv.2024.05.011> [Accessed 14 August 2024]

- Chung, S.Y. 2023. Delivery of healthcare and healthcare education in the digital era and beyond: opportunities and considerations. *Korean Journal of Women Health Nursing*, 29(3):153-159. <https://doi:10.4069/kjwhn.2023.09.06> [Accessed 22 June 2024]
- Chung, K.J. Kim, J., Whangbo, T.K. & Kim, K.H. 2019. The prospect of a new smart healthcare system: A wearable device-based complex structure of position detecting and location recognition system. *International Neurology Journal*, 23(3):180-184. <https://doi.org/10.5213/inj.19381534.077> [Accessed 13 July 2021]
- Cingolani, M., Scendoni, R., Fedeli, P. & Cembrani, F. 2023. Artificial intelligence and digital medicine for integrated home care services in Italy: Opportunities and limits. *Frontiers in Public Health*, 5(10):1095001. <https://doi:10.3389/fpubh.2022.1095001> [Accessed 5 September 2023]
- Clark, M. & Bailey, S. 2024. Chatbots in Health Care: Connecting Patients to Information. *Canadian Journal of Health Technologies*, 4(1). <https://pubmed.ncbi.nlm.nih.gov/38564540/> [Accessed 18 July 2024]
- Cloutier, C. 2024. Strategies for Generating Deliberately Emergent Qualitative Research Designs. *The Journal of Applied Behavioral Science*, 60(2):358-380. <https://doi.org/10.1177/00218863241235417> [Accessed 18 July 2024]
- Cobelli, N. & Blasi, S. 2024. Combining topic modeling and bibliometric analysis to understand the evolution of technological innovation adoption in the healthcare industry. *European Journal of Innovation Management*, 27(9):127-149. <https://doi.org/10.1108/EJIM-06-2023-0497> [Accessed 10 July 2024]
- Coleman, P. 2022. Special Article Validity and Reliability within Qualitative Research in the Caring Sciences. *International Journal of Caring Sciences*, 14(3):2041-2045. <https://www.internationaljournalofcaringsciences.org/> [Accessed 15 February 2023]
- Coman, C., Țîru, L.G., Meseșan-Schmitz, L., Stanciu, C. & Bularca, M.C. 2020. Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective. *Sustainability*, 12(24):10367. <https://doi.org/10.3390/su122410367> [Accessed 3 September 2023]
- Cooksey, R.W. 2020. Descriptive Statistics for Summarising Data. In: Illustrating Statistical Procedures: Finding Meaning in Quantitative Data. Springer, Singapore. https://doi.org/10.1007/978-981-15-2537-7_5 [Accessed 15 February 2023]
- Coster, S., Watkins, M. & Norman, I.J. 2018. What is the impact of professional nursing on patients' outcomes globally? An overview of research evidence. *International Journal of Nursing Studies*, 78:76-83. <https://doi.org/10.1016/j.ijnurstu.2017.10.009> [Accessed 28 March 2023]
- Coopasami, M., Knight, S. & Pete, M. 2017. e-Learning Readiness amongst Nursing Students at the Durban University of Technology. *Health SA Gesondheid (Online)*, 22:300-306. <https://doi.org/10.4102/hsag.v22i0.1059> [Accessed 16 September 2021]
- Cronin, C. 2022. Special Collection Editorial: The digital movement in nursing. *Journal of Research in Nursing*, 27(5):411-420. <https://doi:10.1177/17449871221117437> [Accessed 22 June 2024]
- Crusoe, J., Magnusson, J. & Eklund, J. 2024. Digital transformation decoupling: The impact of willful ignorance on public sector digital transformation. *Government Information Quarterly*, 41(3):101958. <https://doi.org/10.1016/j.giq.2024.101958> [Accessed 20 July 2024]

Cruz-Barrientos, A., Carmona-Barrientos, I., De-la-Fuente-Rodriguez, J.M., Perez-Cabezas, V., Gonzalez-Medina, G. & Sainz-Otero, A.M. 2023. Knowledge, Use and Attitude of Information and Communication Technologies (ICTs) in Graduate Nursing Students: A Correlational Cross-Sectional Study. *Healthcare*, 11(14):1989. <https://doi.org/10.3390/healthcare11141989> [Accessed 14 August 2023]

Cuarteros, K., Ampong, J., Bagares, J. & Berja, J. 2023. Factors Affecting Students' E-Learning Activities Using Exploratory Factor Analysis. *Canadian Journal of Family and Youth / Le Journal Canadien de Famille et de la Jeunesse*, 15. <https://doi.org/10.29173/cjfy29898> [Accessed 29 May 2023]

Cuff, A. The evolution of digital health and its continuing challenges. *BMC Digital Health*, 1(1):3. <https://doi.org/10.1186/s44247-022-00004-x> [Accessed 30 May 2023]

Cui, L., Tong, Z., Wang, R., Fang, X. & Liu, L. 2024. Using an internet-based platform to provide online and offline healthcare services for discharged patients. *BMC Nursing*, 23(486). <https://doi.org/10.1186/s12912-024-02161-y> [Accessed 24 September 2024]

Curioso, W.H., Coronel-Chucos, L.G. & Henríquez-Suarez, M. 2023. Integrating Telehealth for Strengthening Health Systems in the Context of the COVID-19 Pandemic: A Perspective from Peru. *International Journal of Environmental Research and Public Health*, 20(11):5980. <https://doi.org/10.3390/ijerph20115980> [Accessed 5 September 2023]

Curtis, M.G., Wieling, E., Bryant, C., Campbell, R.D. & Kogan, S.M. 2024. Systemic effects of the COVID pandemic on rural black American men's interpersonal relationships: A phenomenological examination. *PLOS ONE*, 19(4): e0297876. <https://doi.org/10.1371/journal.pone.0297876> [Accessed 15 July 2024]

Dabbagh, A., Seens, H., Fraser, J. & MacDermid, J.C. 2023. Construct validity and internal consistency of the Home and Family Work Roles Questionnaires: a cross-sectional study with exploratory factor analysis. *BMC Women's Health*, 23(56). <https://doi.org/10.1186/s12905-023-02199-1> [Accessed 15 September 2023]

Dalawi, I., Isa, M.R., Chen, X.W., Azhar, Z.I. & Aimran, N. 2023. Development of the Malay Language of understanding, attitude, practice and health literacy questionnaire on COVID-19 (MUAPHQ C-19): content validity & face validity analysis. *BMC Public Health*, 23(1):1131. <https://doi.org/10.1186/s12889-023-16044-5> [Accessed 15 September 2023]

Dallora, A.L., Andersson, E.K., Gregory Palm, B., Bohman, D., Björling, G., Marcinowicz, L., Stjernberg, L. & Anderberg, P. 2024. Nursing Students' Attitudes Toward Technology: Multicenter Cross-Sectional Study. *JMIR Medical Education*, 10: e50297. <https://doi.org/10.2196/50297> [Accessed 10 July 2024]

Damascena, S.C.C., Santos, K.C.B., Lopes, G.S.G., Gontijo, P.V.C., Paiva, M.V.S., Lima, M.E.S., Alves, J.M.F. & Campos, R.S. 2019. Use of Digital Educational Technologies as a Teaching Tool in the Nursing Teaching Process. *Brazilian Journal of Development*, 5:29925–29939. <https://www.mdpi.com/2075-4426/11/10/1010/html> [Accessed 11 June 2022]

Dangal, M. 2021. Survey Design Quantitative research. <https://doi.org/10.13140/RG.2.2.10886.50242> [Accessed 11 February 2023]

Daramola, G.O., Adewumi, A., Jacks, B.S. & Ajala, O.A. 2024. Navigating Complexities: A review of communication barriers in multinational energy projects. *International Journal of Applied*

Research in Social Sciences, 6(4). <https://doi.org/10.51594/ijarss.v6i4.1062> [Accessed 18 July 2024]

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B. & Osher, D. 2020. Implications for educational practice of the science of learning and development. *Applied Developmental Science*, 24(2):97–140. <https://doi.org/10.1080/10888691.2018.1537791> [Accessed 15 September 2023]

Datta, P. 2023. The promise and challenges of the 4IR. *Journal of Information Technology Teaching Cases*, 13(1):2–15. <https://doi.org/10.1177/20438869211056938> [Accessed 6 September 2023]

Dave, T., Athaluri, S.A. & Singh, S. 2023. ChatGPT in medicine: an overview of its applications, advantages, limitations, future prospects, and ethical considerations. *Frontiers in Artificial Intelligence*, 6:1169595. <https://doi.org/10.3389/frai.2023.1169595> [Accessed 17 September 2023]

Dave, M. & Patel, N. 2023. Artificial intelligence in healthcare and education. *British Dental Journal*, 234(10):761-764. <https://doi.org/10.1038/s41415-023-5845-2> [Accessed 11 October 2023]

David-Olawade, A.C., Olawade, D.B., Ojo, I.O., Famujimi, M.E., Olawumi, T.T. & Esan, D.T. 2024. Nursing in the Digital Age: Harnessing telemedicine for enhanced patient care. *Informatics and Health*, 1(2):100-110. <https://doi.org/10.1016/j.infoh.2024.07.003> [Accessed 14 August 2024]

Dawadi, S., Shrestha, S. & Giri, R. A. 2021. Mixed-Methods Research: A Discussion on its Types, Challenges, and Criticisms. *Journal of Practical Studies in Education*, 2(2):25-36. <https://doi.org/10.46809/jpse.v2i2.20> [Accessed 21 June 2024]

Dawson, Fisher, E. & Wiese, J. 2024. Hospital Employee Experiences Caring for Patients in Smart Patient Rooms. *CHI: Proceedings of the CHI Conference on Human Factors in Computing Systems*, 454:1– 16. <https://doi.org/10.1145/3613904.3642201> [Accessed 10 July 2024]

de Castro Sobrosa Neto, R., Sobrosa Maia, J., de Silva Neiva, S., Scalia, M.D., Salgueirinho, J.B. & de Andrade Guerra, O. 2020. The fourth industrial revolution and the coronavirus: a new era catalyzed by a virus. *Research in Globalization*, 2(2):100024. <https://doi.org/10.1016/j.resglo.2020.100024> [Accessed 10 September 2023]

De Gagne, J.C. 2023. The State of Artificial Intelligence in Nursing Education: Past, Present, and Future Directions. *International Journal of Environmental Research and Public Health*, 20(6):4884. <https://doi.org/10.3390/ijerph20064884> [Accessed 22 June 2024]

De Calheiros Velozo, J., Habets, J., George, S.V., Niemeijer, K., Minaeva, O., Hagemann, N., Herff, C., Kuppens, P., Rintala, A. & Vaessen, T. 2024. Designing daily life research combining experience sampling method with parallel data. *Psychological Medicine*, 54(1):98-107. <https://doi.org/10.1017/S0033291722002367> [Accessed 15 July 2024]

De Leeuw, J.A., Woltjer, H. & Kool, R.B. 2020. Identification of Factors Influencing the Adoption of Health Information Technology by Nurses Who Are Digitally Lagging: In-Depth Interview Study. *Journal of Medical Internet Research*, 22(8): e15630. <https://doi.org/10.2196/15630> [Accessed 13 June 2024]

Dehalwar, K. & Sharma, S.N. 2024. Exploring the Distinctions between Quantitative and Qualitative Research Methods. *Think India Journal*, 27(1). <https://doi.org/10.5281/zenodo.10553000> [Accessed 15 July 2024]

Delardes, B., McLeod, L., Chakraborty, S. & Bowles, K.A. 2020. What is the effect of electronic clinical handovers on patient outcomes? A systematic review. *Health Informatics Journal*, 4:2422-2434. <https://doi:10.1177/1460458220905162> [Accessed 4 June 2023]

Demorest, S., Cook, C., Schenk, E., Harris, L.W. & Earley, A. 2024. School of Nursing Climate Commitment: Nursing Faculty Bring Climate to the Classroom. *International Journal of Environmental Research and Public Health*, 21(5):589. <https://doi.org/10.3390/ijerph21050589> [Accessed 18 July 2024]

Dempere, J., Modugu, K., Hesha m, A. & Ramasamy, L.K. 2023. The impact of ChatGPT on higher education. *Frontiers in Education*, 8:1-13. <https://doi:10.3389/feduc.2023.1206936> [Accessed 17 September 2023]

Deo, N. & Anjankar, A. 2023. Artificial Intelligence with Robotics in Healthcare: A Narrative Review of Its Viability in India. *Cureus*, 15(5): e39416. <https://doi:10.7759/cureus.39416> [Accessed 24 June 2024]

Detwal, P.K., Agrawal, R., Samadhiya, A., Kumar, A. & Garza-Reyes, J.A. 2024. Revolutionizing healthcare organizations with Operational Excellence and Healthcare 4.0: a systematic review of the state-of-the-art literature. *International Journal of Lean Six Sigma*, 15(1):80-102. <https://doi.org/10.1108/IJLSS-04-2023-0061> [Accessed 10 July 2024]

Dietl, J.E., Derksen, C., Keller, F.M., Schmiedhofer, M & Lippke, S. 2023. Psychosocial Processes in Healthcare Workers: How Individuals' Perceptions of Interpersonal Communication Is Related to Patient Safety Threats and Higher-Quality Care. *International Journal of Environmental Research and Public Health*, 20(9):5698. <https://doi.org/10.3390/ijerph20095698> [Accessed 12 June 2024]

Dion, H. & Evans, M. 2024. Strategic frameworks for sustainability and corporate governance in healthcare facilities; approaches to energy-efficient hospital management. *Benchmarking: An International Journal*, 31(2):353-390. <https://doi:10.1108/BIJ-04-2022-0219> [Accessed 14 July 2024]

Dissanayake, D.M.A.P., Dharmasena, K.P. & Warnakulasuriya, S.S.P. 2024. Challenges of integrating patient safety into nursing curricula: An integrative literature review. *Journal of Patient Safety and Risk Management*, 29(1):8-35. <https://doi:10.1177/25160435231222808> [Accessed 24 September 2024]

Dodson, P., Haase, A.M., Jeffreys, M. & Hales, C. 2024. Capturing patient experiences of care with digital technology to improve service delivery and quality of care: A scoping review. *DIGITAL HEALTH*, 10. <https://doi:10.1177/20552076241282900> [Accessed 22 September 2024]

Dogan, S., Dogan, N.A. & Celik, I. 2021. Teachers' skills to integrate technology in education: Two path models explaining instructional and application software use. *Education and Information Technology*, 26:1311–1332. <https://doi.org/10.1007/s10639-020-10310-4> [Accessed 28 March 2023]

Donough, G. 2023. 'Nursing students' experiences of clinical assessment at a university in South Africa'. *Health SA Gesondheid*, 28(0): a2161. <https://doi.org/10.4102/hsag.v28i0.2161> [Accessed 31 May 2023]

- Donough, G. 2022. Designing Theoretical Assessments at Nursing Higher Education Institutions: A Scoping Review. *South African Journal of Higher Education*, 36(2):79-98. <https://dx.doi.org/10.20853/36-2-4699> [Accessed 13 June 2024]
- Dolot, A. 2018. The characteristics of Generation Z. *E-mentor*, 44-50. <https://doi.org/10.15219/em74.1351> [Accessed 28 March 2023]
- Domenteanu, A., Cibu, B. & Delcea, C. 2024. Mapping the Research Landscape of Industry 5.0 from a Machine Learning and Big Data Analytics Perspective: A Bibliometric Approach. *Sustainability*, 16(7):2764. <https://doi.org/10.3390/su16072764> [Accessed 14 July 2024]
- Dong, Y., Ahmad, S.F., Irshad, M., Al-Razgan, M., Ali, Y.A. & Awwad, E.M. 2023. The Digitalization Paradigm: Impacts on Agri-Food Supply Chain Profitability and Sustainability. *Sustainability*, 15(21):15627. <https://doi.org/10.3390/su152115627> [Accessed 13 June 2024]
- Dorais, S. 2024. Time series analysis in preventive intervention research: A step-by-step guide. *Journal of Counseling & Development*, 102:239–250. <https://doi.org/10.1002/jcad.12508> [Accessed 15 July 2024]
- Dotsey, S. 2023. Foreign Healthcare Workers and COVID-19 in Europe: The Paradox of Unemployed Skilled Labour. *Social Sciences*, 12:1-14. <https://doi.org/10.3390/socsci12040211> [Accessed 11 September 2023]
- Drew, C. 2023. 27 Top Threats to Internal Validity in Research. Helpful Professor. <https://helpfulprofessor.com/threats-to-internal-validity/> [Accessed 23 September 2023]
- Drolet, M.J., Rose-Derouin, E., Leblanc, J.C., Ruest, M. & Williams-Jones, B. 2023. Ethical Issues in Research: Perceptions of Researchers, Research Ethics Board Members and Research Ethics Experts. *Journal of Academic Ethics*, 21:269–292. <https://doi.org/10.1007/s10805-022-09455-3> [Accessed 29 May 2023]
- Drott, J., Engström, M., Jangland, E., Fomichov, V., Malmström, M. & Jakobsson, J. 2023. Factors related to successful professional development for specialist nurses in surgical care: a cross-sectional study. *BMC Nursing*, 22(1):79. <https://doi.org/10.1186/s12912-023-01258-0> [Accessed 23 February 2023]
- Duignan, B. & Leong, E. 2023. Inventors and Inventions of the Industrial Revolution. Encyclopedia Britannica. <https://www.britannica.com/list/inventors-and-inventions-of-the-industrial-revolution> [Accessed 15 September 2023]
- Dunwoodie, K., Macaulay, L & Newman, A. 2022. Qualitative interviewing in the field of work and organisational psychology: Benefits, challenges and guidelines for researchers and reviewers. *Applied Psychology*, 72(2):863–889. <https://doi.org/10.1111/apps.12414> [Accessed 10 June 2024]
- Dykema, J., Schaeffer, N.C., Garbarski, D., Assad, N. & Blixt, S. 2022. Towards a reconsideration of the use of agree-disagree questions in measuring subjective evaluations. *Research in Social Administrative Pharmacy*, 18(2):2335-2344. <https://doi.org/10.1016/j.sapharm.2021.06.014> [Accessed 10 June 2024]
- Dykes, S. & Chu, C.H. 2020. Now more than ever, nurses need to be involved in technology design: Lessons from the COVID-19 pandemic. *Journal of Clinical Nursing*, 30(7–8). <https://doi.org/10.1111/jocn.15581> [Accessed 20 August 2024]

Ebanks, C. 2024. What are the experiences of student nurses with online learning? Do they have the necessary digital and technological competencies? *Journal of Nursing Education and Practice*, 14(6):22. <https://doi.org/10.5430/jnep.v14n6p22> [Accessed 15 July 2024]

Ebbers, T., Takes, R.P., Smeele, L.E., Kool, R.B., van den Broek, G.B. & Dirven, R. 2024. The implementation of a multidisciplinary, electronic health record embedded care pathway to improve structured data recording and decrease electronic health record burden. *International Journal of Medical Informatics*, 184:105344. <https://doi.org/10.1016/j.ijmedinf.2024.105344> [Accessed 24 July 2024]

Eckel, J. 2023. External Validity: Definition, Types, Threats & Examples [Original source: <https://studycrumb.com/external-validity>] [Accessed 22 September 2023]

Eggleston, J. 2024. Frequent Survey Requests and Declining Response Rates: Evidence from the 2020 Census and Household Surveys. *Journal of Survey Statistics and Methodology*, smae022. <https://doi.org/10.1093/jssam/smae022> [Accessed 18 July 2024]

Egici, M.T., Özmen Sever, S., Zeren Öztürk, G., Bektemür, G., Bağcı, H. & Bukhari, M.H. 2024. What do medical faculty students think about telehealth? *Pakistan Journal of Medical Sciences*, 40(8). <https://doi.org/10.12669/pjms.40.8.9055> [Accessed 20 August 2024]

Elliott, M.N., Brown, J.A., Hambarsoomian, K., Parast, L., Beckett, M.K., Lehrman, W.G., Giordano, L.A., Goldstein, E.H. & Cleary, P.D. 2024. Survey Protocols, Response Rates, and Representation of Underserved Patients: A Randomized Clinical Trial. *JAMA Health Forum*, 5(1): e234929. <https://doi:10.1001/jamahealthforum.2023.4929> [Accessed 20 July 2024]

Ellis, J. & Hart, D. 2023. Strengthening the Choice of a Generic Qualitative Research Design. *The Qualitative Report*, 28:1759-1768. <https://doi.org/10.46743/2160-3715/2023.5474> [Accessed 15 July 2024]

ElSayary, A. 2024. An investigation of teachers' perceptions of using ChatGPT as a supporting tool for teaching and learning in the digital era. *Journal of Computer Assisted Learning*, 40(3):931–945. <https://doi.org/10.1111/jcal.12926> [Accessed 18 July 2024]

Encarnação, R., Manuel, T., Palheira, H., Neves-Amado, J. & Alves, P. 2024. Artificial Intelligence in Wound Care Education: Protocol for a Scoping Review. *Nursing Reports*, 14(1):627-640. <https://doi:10.3390/nursrep14010048> [Accessed 21 June 2024]

Esch, T., Stefano, G.B. & Michaelsen, M.M. 2024. The foundations of mind-body medicine: Love, good relationships, and happiness modulate stress and promote health. *Stress and Health*, e3387. <https://doi.org/10.1002/smi.3387> [Accessed 15 July 2024]

Escobedo, P., Pousibet-Garrido, A., López-Ruiz, N., Carvajal, M.A., Palma, A.J. & Martínez-Olmos, A. 2024. "Bed-Based Ballistocardiography System Using Flexible RFID Sensors for Noninvasive Single- and Dual-Subject Vital Signs Monitoring." in *IEEE Transactions on Instrumentation and Measurement*, 73:1-12. <https://doi:10.1109/TIM.2024.3369134>. [Accessed 24 July 2024]

Esmailzadeh, P., Dharanikota, S. & Mirzaei, T. 2024. The role of patient engagement in patient-centric health information exchange (HIE) initiatives: An empirical study in the United States. *Information Technology & People*, 37(2):521–552. <https://doi.org/10.1108/ITP-05-2020-0316> [Accessed 24 September 2024]

- Espinoza, J. & Derrington, S. 2021. How Should Clinicians Respond to Language Barriers That Exacerbate Health Inequity? *AMA Journal of Ethics*, 23(2): E109-116.
<https://doi.org/10.1001/amajethics.2021.109> [Accessed 13 June 2024]
- Eyzaguirre, I.A.L. & Fernandes, M.E.B. 2024. Combining methods to conduct a systematic review and propose a conceptual and theoretical framework in socio-environmental research. *MethodsX*, 12:102484. <https://doi.org/10.1016/j.mex.2023.102484> [Accessed 15 July 2024]
- Faganel, A., Pačarić, F. & Rižnar, I. 2024. The Impact of Gamification on Slovenian Consumers' Online Shopping. *Administrative Sciences*, 14(5):86. <https://doi.org/10.3390/admsci14050086> [Accessed 24 July 2024]
- Faizi, N & Alvi, Y. 2023. Biostatistics Manual for Health Research: *A Practical Guide to Data Analysis*. Academic Press. <https://doi.org/10.1016/C2022-0-00374-3> [Accessed 7 October 2023]
- Faloye, S.T. & Faniran, V. 2023. Integrating technology in teaching and learning practices: students' competencies. *South African Computer Journal*, 35(1):101-114.
<https://dx.doi.org/10.18489/sacj.v35i1.1111> [Accessed 16 September 2023]
- Fanoro, M., Božanić, M. & Sinha, S. 2021. A Review of 4IR/5IR Enabling Technologies and Their Linkage to Be Manufacturing Supply Chain. *Technologies*, 9(4):77.
<https://doi.org/10.3390/technologies9040077> [Accessed 5 September 2023]
- Fan, K & Zhao, Y. 2022. Mobile health technology: a novel tool in chronic disease management: *Intelligent Medicine*, 2(1):41-47. <https://doi.org/10.1016/j.imed.2021.06.003> [Accessed 2 April 2023]
- Farkas, B.C., Krajcsi, A., Janacsek, K. & Nemeth, D. 2023. The complexity of measuring reliability in learning tasks: An illustration using the Alternating Serial Reaction Time Task. *Behavior Research Methods*, 56(1):301-317. <https://doi.org/10.3758/s13428-022-02038-5> [Accessed 17 September 2023]
- Farokhzadian, J., Mangolian Shahrabaki, P., Farahmandnia, H., Eskici, G.T. & Goki, F.S. 2024. Nurses' challenges for disaster response: a qualitative study. *BMC Emergency Medicine*, 24(1).
<https://doi.org/10.1186/s12873-023-00921-8> [Accessed 13 June 2024]
- Farokhzadian, J., Khajouei, R., Hasman, A. & Ahmadian, L. 2020. Nurses' experiences and viewpoints about the benefits of adopting information technology in health care: a qualitative study in Iran. *BMC Medical Informatics and Decision Making*, 20(240).
<https://doi.org/10.1186/s12911-020-01260-5> [Accessed 22 July 2024]
- Farrell, W.C., Bogodistov, Y. & Mössenlechner, C. 2023. "Is Academic Integrity at Risk? Perceived Ethics and Technology Acceptance of ChatGPT". *AMCIS 2023 Proceedings*, 24.
https://aisel.aisnet.org/amcis2023/sig_ed/sig_ed/24 [Accessed 17 September 2023]
- Faulconer, E., Griffith, J & Gruss, A. 2021. The impact of positive feedback on student outcomes and perceptions. *Assessment & Evaluation in Higher Education*, 47:1-10.
<https://doi.org/10.1080/02602938.2021.1910140> [Accessed 2 April 2023]
- Fealy, S., Irwin, P., Tacgin, Z., See, Z.S. & Jones, D. 2023. Enhancing Nursing Simulation Education: A Case for Extended Reality Innovation. *Virtual Worlds*, 2(3):218-230.
<https://doi.org/10.3390/virtualworlds2030013> [Accessed 7 October 2023]

- Feller, F. 2018. Transforming Nursing Education: A Call for a Conceptual Approach. *Nursing Education Perspectives*, 39(2):105-106. <https://10.1097/01.nep.0000000000000187> [Accessed 11 September 2023]
- Feng, Y.S. 2023. The First Industrial Revolution's Consequences and Repercussions for Europe and America HISTORY: *HKU History Journal Society*, 3:57-67. <http://dx.doi.org/10.2139/ssrn.4558546> [Accessed 17 September 2023]
- Ferreira, D.C., Vieira, I., Pedro, M.I., Caldas, P. & Varela, M. 2023. Patient Satisfaction with Healthcare Services and Techniques Used for its Assessment: A Systematic Literature Review and a Bibliometric Analysis. *Healthcare*, 11(5):639. <https://doi.org/10.3390/healthcare11050639> [Accessed 15 October 2023]
- Ferreira, C., Andrade, P & Almeida, F. 2020. How to Improve the Validity and Reliability of a Case Study Approach. *Journal of Interdisciplinary Studies in Education*, 9:273-284. <https://doi.org/10.32674/jise.v9i2.2026> [Accessed 9 March 2023]
- Fetzer, S.J. Considering Research Denominators. *Journal of Perianesthesia Nursing*, 35(4):447. <https://doi.org/10.1016/j.jopan.2020.05.003> [Accessed 15 September 2023]
- Fields, L., Dean, B.A., Perkiss, S. & Moroney, T. 2024. Nursing action towards the sustainable development goals: Barriers and opportunities. *Nurse Education Today*, 134:106102. <https://doi.org/10.1016/j.nedt.2024.106102> [Accessed 12 July 2024]
- Fields, B., Carbery, M., Schulz, R., Rodakowski, J., Terhorst, L. & Still, C. 2023. Evaluation of Face Validity and Acceptability of the Care Partner Hospital Assessment Tool. *Innovation in Aging*, 7(2): igad011. <https://doi.org/10.1093/geroni/igad011> [Accessed 15 February 2023]
- Fife, S.T. & Gossner, J.D. 2024. Deductive Qualitative Analysis: Evaluating, Expanding, and Refining Theory. *International Journal of Qualitative Methods*, 23. <https://doi.org/10.1177/16094069241244856> [Accessed 20 July 2024]
- Fischer, H.E., Boone, W.J. & Neumann, K. 2023. Quantitative research designs and approaches. In *Handbook of research on science education*, 28-59. Routledge. <https://www.taylorfrancis.com/chapters/edit/10.4324/9780367855758-3/quantitative-research-designs-approaches-hans-fischer-william-boone-knut-neumann> [Accessed 13 May 2023]
- Fisher, P. 2024. A generation divided: The politics of Generation X. *Politics & Policy*, 00(0). <https://doi.org/10.1111/polp.12620> [Accessed 20 July 2024]
- Flannelly, K.J., Flannelly, L.T. & Jankowski, K.R.B. 2018. Threats to the Internal Validity of Experimental and Quasi-Experimental Research in Healthcare. *Journal of Health Care Chaplaincy*, 24(3):107-130. <https://doi.org/10.1080/08854726.2017.1421019> [Accessed 9 March 2023]
- Flynn, M.K. & Rocheleau, C. 2024. Undergraduate Research Pools in Psychology Departments: Prevalence and Practices. *Teaching Psychology*, 51(1):39-45. <https://doi.org/10.1177/00986283211070640> [Accessed 15 July 2024]
- Folger, D., Merenmies, J., Sjöberg, L. & Pyörälä, E. 2021. Hurdles for adopting mobile learning devices at the outset of clinical courses. *BMC Medical Education*, 21:594. <https://doi.org/10.1186/s12909-021-03008-9> [Accessed 24 September 2024]

Folger, T.D., Bostic, J. & Krupa, E.E. 2023. Defining Test-Score Interpretation, Use, and Claims: Delphi Study for the Validity Argument. *Educational Measurement: Issues and Practice*, 42(3):22-38. <https://doi.org/10.1111/emip.12569> [Accessed 23 September 2023]

Foster, C. 2023. Methodological pragmatism in educational research: from qualitative-quantitative to exploratory-confirmatory distinctions. *International Journal of Research & Method in Education*, 47(1):4–19. <https://doi.org/10.1080/1743727X.2023.2210063> [Accessed 18 July 2024]

Frank, T.D. 2023. Eigenvalue analysis of SARS-CoV-2 viral load data: illustration for eight COVID-19 patients. *International Journal of Data Science and Analytics*, 15(3):281-290. <https://doi.org/10.1007/s41060-022-00319-y> [Accessed 30 August 2023]

Franz, D. 2023. Quantitative research without measurement. Reinterpreting the better-than-average-effect. *New Ideas in Psychology*, 68:100976 <https://doi.org/10.1016/j.newideapsych.2022.100976> [Accessed 31 May 2023]

Frennert, S., Petersson, L. & Erlingsdottir, G. 2023. “More” work for nurses: the ironies of eHealth. *BMC Health Services Research*, 23:411. <https://doi.org/10.1186/s12913-023-09418-3> [Accessed 5 September 2023]

Frisby, M.B. 2024. Critical Quantitative Literacy: An Educational Foundation for Critical Quantitative Research. *AERA Open*, 10. <https://doi.org/10.1177/23328584241228223> [Accessed 18 July 2024]

Frølund, J.C., Løkke, A., Jensen, H.I. & Farver-Vestergaard, I. 2024. The Use of Podcasts as Patient Preparation for Hospital Visits—An Interview Study Exploring Patients’ Experiences. *International Journal of Environmental Research and Public Health*, 21(6):746. <https://doi.org/10.3390/ijerph21060746> [Accessed 14 August 2024]

Frøiland, C.T., Husebø, A.M.L., Aase, I., Akerjordet, K. & Laugaland, K. 2023. A digital educational resource to support and enhance effective mentorship practices of nursing students in nursing homes: a qualitative study. *BMC Nursing*, 22(1):423. <https://doi.org/10.1186/s12912-023-01570-9> [Accessed 29 May 2024]

Fu, Y., Fan, X. & Cao, J. 2024. "An imputation method based on the varimax variant of multivariate singular spectrum analysis," in *IEEE Access*. <https://doi.org/10.1109/ACCESS.2024.3429292> [Accessed 20 July 2024]

Fulk, G. 2023. Descriptive Statistics, An Important First Step. *Journal of Neurologic Physical Therapy*, 47(2):63. <https://doi.org/10.1097/NPT.0000000000000434> [Accessed 22 September 2023]

Gajdics, J. & Jagodics, B. 2022. Mobile Phones in Schools: With or Without you? Comparison of Students’ Anxiety Level and Class Engagement After Regular and Mobile-Free School Days. *Technology, Knowledge and Learning*, 27:1095–1113. <https://doi.org/10.1007/s10758-021-09539-w> [Accessed 15 November 2023]

Gala, D., Behl, H., Shah, M. & Makaryus, A.N. 2024. The Role of Artificial Intelligence in Improving Patient Outcomes and Future of Healthcare Delivery in Cardiology: A Narrative Review of Literature. *Healthcare*, 12(4):481. <https://doi.org/10.3390/healthcare12040481> [Accessed 15 July 2024]

Galiano, M.A., Moreno Fergusson, M.E., Guerrero, W.J., Muñoz, M.F., Ortiz Basto, G.A., Cardenas Ramírez, J.S., Guevara Lozano, M. & Larraín Sundt, A. 2024. Technological

innovation for workload allocation in nursing care management: an integrative review. *F1000Research*, 12:104. <https://doi:10.12688/f1000research.125421.2> [Accessed 24 September 2024]

Gamage, C.K.W. & Sudusinghe, W.S. 2024. Unveiling the heart of nursing: the transformative impact of emotional intelligence on patient-centered care. *Asian Journal of Internal Medicine*, 3(1):36-41. <https://doi:10.4038/ajim.v3i1.129> [Accessed 15 July 2024]

Gamaliel, R.T. 2023. The Different Conceptualisations of Generations in Literature. *Open Journal of Social Sciences*, 11:106-119. <https://doi:10.4236/jss.2023.117008> [Accessed 15 July 2024]

Gammoh, L.A. 2024. ChatGPT in academia: exploring university students' risks, misuses, and challenges in Jordan. *Journal of Further and Higher Education*, 1–17. <https://doi.org/10.1080/0309877X.2024.2378298> [Accessed 18 July 2024]

Gandhi, T.K., Classen, D., Sinsky, C.A., Rhew, D.C., Van de Garde, N., Roberts, A. & Federico, F. 2023. How can artificial intelligence decrease cognitive and work burden for front line practitioners? *JAMIA Open*, 6(3):79. <https://doi:10.1093/jamiaopen/ooad079> [Accessed 11 October 2023]

Gause, G., Mokgaola, I.O. & Rakhudu, M.A. 2022. Technology usage for teaching and learning in nursing education: An integrative review. *Curationis*, 45(1): e1-e9. <https://doi:10.4102/curationis.v45i1.2261> [Accessed 14 September 2023]

Gebremedhin, M., Gebrewahd, E. & Stafford, L.K. 2022. Validity and reliability study of clinician attitude towards rural health extension program in Ethiopia: exploratory and confirmatory factor analysis. *BMC Health Services Research*, 22:1088. <https://doi.org/10.1186/s12913-022-08470-9> [Accessed 7 October 2023]

Gegenfurtner, A., Schmidt-Hertha, B & Lewis, P. 2020. Digital technologies in training and adult education. *International Journal of Training and Development*, 24:1-4. <https://doi.org/10.1111/ijtd.12172> [Accessed 13 September 2023]

Georgadarellis, G.L., Cobb, T., Vital, C.J. & Sup, F.C. 2024. Nursing Perceptions of Robotic Technology in Healthcare: A Pretest–Posttest Survey Analysis Using an Educational Video. *IJSE Transactions on Occupational Ergonomics and Human Factors*, 12(1–2):68–83. <https://doi.org/10.1080/24725838.2024.2323061> [Accessed 10 July 2024]

George, A.S. 2024. Universal Internet Access: A Modern Human Right or a Path to Digital Colonialism. *Partners Universal International Innovation Journal*, 2(2):55–74. <https://doi.org/10.5281/zenodo.10970024> [Accessed 20 July 2024]

George, A.S., George, A.S.H. & Baskar, T. 2024. Artificial Intelligence and the Future of Healthcare: Emerging Jobs and Skills in 2035. *Partners Universal Multidisciplinary Research Journal*, 1(1):1-21. <https://doi:10.5281/zenodo.11176554> [Accessed 14 July 2024]

George, A.S. 2024. Bridging the Digital Divide: Understanding the Human Impacts of Digital Transformation. *Partners Universal International Innovation Journal*, 2(3). <https://doi:10.5281/zenodo.11287684> [Accessed 10 July 2024]

George, T. 2023. Semi-Structured Interview | Definition, Guide & Examples. Scribbr. Retrieved September 4, 2023, from <https://www.scribbr.com/methodology/semi-structured-interview/>

George, T. 2023. Mixed Methods Research | Definition, Guide & Examples. Scribbr. Retrieved September 14, 2023, from <https://www.scribbr.com/methodology/mixed-methods-research/>

George, T. 2022. Types of Interviews in Research | Guide & Examples. Scribbr. <https://www.scribbr.com/methodology/interviews-research/> [Accessed 14 February 2023]

Ghafar, Z. 2024. Digital Technologies in Health Care: A Comprehensive Review of Current Status and Future Perspectives. *International Journal of Applied and Scientific Research*, 2:353-370. <https://doi:10.59890/ijasr.v2i3.1558> [Accessed 15 July 2024]

Ghanad, A. 2023. An Overview of Quantitative Research Methods. *International Journal of Multidisciplinary Research and Analysis*, 6. <https://10.47191/ijmra/v6-i8-52> [Accessed 13 June 2024]

Ghanbari-Afra, L., Adib-Hajbaghery, M. & Dianati, M. 2022. Human Caring: A Concept Analysis. *Journal of Caring Sciences*, 11(4):246-254. <https://doi:10.34172/jcs.2022.21> [Accessed 22 June 2024]

Ghani, B., Memon, K.R., Han, H., Ariza-Montes, A. & Arjona-Fuentes, J.M. 2022. Work stress, technological changes, and job insecurity in the retail organization context. *Frontiers in Psychology*, 13:918065. <https://doi:10.3389/fpsyg.2022.918065> [Accessed 22 June 2024]

Ghasemi, M.R., Moonaghi, H.K. & Heydari, A. 2020. Strategies for sustaining and enhancing nursing students' engagement in academic and clinical settings: a narrative review. *Korean Journal of Medical Education*, 32(2):103-117. <https://doi.org/10.3946/kjme.2020.159> [Accessed 28 March 2023]

Giesen, J., Timmerman, I., Bakker-Jacobs, A., Berings, M., Huisman-de Waal, G., Van Vught, A. & Vermeulen, H. 2024. What can nurses learn from patient's needs and wishes when developing an evidence-based quality improvement learning culture? A qualitative study. *Scandinavian Journal of Caring Sciences*, 00:1–12. <https://doi.org/10.1111/scs.13252> [Accessed 15 July 2024]

Giner-Sorolla, R., Montoya, A.K., Reifman, A., Carpenter, T., Lewis, N.A., Aberson, C.L., Bostyn, D.H., Conrique, B.G., Ng, B.W., Schoemann, A.M. & Soderberg, C. 2024. Power to Detect What? Considerations for Planning and Evaluating Sample Size. *Personality and Social Psychology Review*, 28(3):276-301. <https://doi.org/10.1177/10888683241228328> [Accessed 18 July 2024]

Gizdic, A., Baxter, T., Barrantes-Vidal, N. & Park, S. 2023. Social connectedness and resilience post COVID-19 pandemic: Buffering against trauma, stress, and psychosis. *Psychiatry Research Communications*, 3:100126. <https://doi:10.1016/j.psycom.2023.100126> [Accessed 24 July 2024]

Glaubergerman, G., Ito-Fujita, A., Katz, S. & Callahan, J. 2023. Artificial Intelligence in Nursing Education: Opportunities and Challenges. *Hawaii Journal of Health and Social Welfare*, 82(12):302-305. <https://pmc.ncbi.nlm.nih.gov/articles/PMC10713739/> [Accessed 24 July 2024]

Glarcher, M. & Vaismoradi, M. 2024. A systematic integrative review of specialized nurses' role to establish a culture of patient safety: A modelling perspective. *Journal of Advanced Nursing*, 00:1–16. <https://doi.org/10.1111/jan.16105> [Accessed 15 July 2024]

Golightly, L., Chang, V., Xu, Q., Gao, X. & Liu, B. 2022. Adoption of cloud computing as an innovation in the organization. *International Journal of Engineering Business Management*, 14:184797902210939. <https://doi:10.1177/18479790221093992> [Accessed 11 November 2023]

Gonçalves-Bradley, D.C., J Maria, A.R., Ricci-Cabello, I., Villanueva, G., Fønhus, M.S., Glenton, C., Lewin, S., Henschke, N., Buckley, B.S., Mehl, G.L., Tamrat, T. & Shepperd, S. 2020. Mobile technologies to support healthcare provider to healthcare provider communication and management of care. *Cochrane Database of Systemic Reviews*, 8(8):CD012927. <https://doi:10.1002/14651858> [Accessed 10 July 2024]

Gong, A.J., Bolsegui, M.L., Lee, E.E., Mathai, S.C. & Weiss, C.R. 2024. Assessing the Psychometric Validity of the Epistaxis Severity Score: Internal Consistency and Test–Retest Reliability. *American Journal of Rhinology & Allergy*, 38(1):38–46. <https://doi:10.1177/19458924231207137> [Accessed 20 July 2024]

Gopo, C. 2022. The role of technology in the 21st century education of learners. https://www.researchgate.net/publication/359849731_The_role_of_technology_in_the_21st_century_education_of_learners/citation/download [Accessed 11 October 2023]

Gordon, M., Daniel, M., Ajiboye, A., Uraiby, H., Xu, N.Y., Bartlett, R., Hanson, J., Haas, M., Spadafore, M., Grafton-Clarke, C., Gasiea, R.Y., Michie, C., Corral, J., Kwan, B., Dolmans, D. & Goumas, G., Dardavesis, T.I., Syrigos, K., Syrigos, N. & Simou, E. 2024. Chatbots in Cancer Applications, Advantages and Disadvantages: All that Glitters Is Not Gold. *Journal of Personalized Medicine*, 14(8):877. <https://doi.org/10.3390/jpm14080877> [Accessed 14 August 2024]

Graebe, J. 2024. Advancing Nursing Practice: The Evolution and Impact of Continuing Professional Development. *The Journal of Continuing Education in Nursing*, 55(4):153–156. <https://doi.org/10.3928/00220124-20240318-02> [Accessed 15 July 2024]

Grainger, R., Liu, Q. & Gladman, T. 2024. Learning technology in health professions education: Realising an (un)imagined future. *Medical Education*, 58(1):36–46. <https://doi.org/10.1111/medu.15185> [Accessed 15 July 2024]

Grant, S.C. 2021. Informed Consent-We Can and Should Do Better. *JAMA Network Open*, 4(4): e2110848. <https://doi:10.1001/jamanetworkopen.2021.10848> [Accessed 29 May 2023]

Grimwood, T. & Snell, L. 2020. The use of technology in healthcare education: a literature review [version 1]. *MedEdPublish*, 9:137. <https://doi.org/10.15694/mep.2020.000137.1> [Accessed 20 July 2024]

Gronseth, S.L. & Hutchins, H.M. 2021. Flexibility in formal workplace learning: technology applications for engagement through the lens of universal design for learning. *Tech Trends*, 64:211–218. <https://doi.org/10.1007/s11528-019-00455-6> [Accessed 24 June 2024]

Guillari, A., Sansone, V., Giordano, V., Catone, M. & Rea, T. 2024. Assessing digital health knowledge, attitudes and practices among nurses in Naples: a survey study protocol. *BMJ Open*, 14: e081721. <https://doi:10.1136/bmjopen-2023-081721> [Accessed 18 July 2024]

Gumpili, S.P. & Das, A.V. 2022. Sample size and its evolution in research. *IHOPE Journal of Ophthalmology*, 1:9–13. https://doi:10.25259/IHOPEJO_3_2021 [Accessed 10 June 2023]

Gunawan, J. 2023. Exploring the future of nursing: Insights from the ChatGPT model. *Belitung Nursing Journal*, 9(1):1–5. <https://doi:10.33546/bnj.2551> [Accessed 17 September 2023]

Guraya, S.S., Harkin, D.W., Yusoff, M.S.B. & Guraya, S.Y. 2023. Paradigms unfolded - developing, validating, and evaluating the Medical Education e-Professionalism framework from a

philosophical perspective. *Frontiers in Medicine*, 10:1230620.
<https://doi.org/10.3389/fmed.2023.1230620> [Accessed 18 July 2024]

Haanes, G.G., Nilsen, E., Mofossbakke, R., Wighus, M. & Ravik, M. 2024. Digital learning in nursing education: lessons from the COVID-19 lockdown. *BMC Nursing*, 23(646).
<https://doi.org/10.1186/s12912-024-02312-1> [Accessed 24 September 2024]

Habib, T., Nair, A., Von Pressentin, K., Kaswa, R. & Saeed, H. 2023. Do not lose your patient in translation: Using interpreters effectively in primary care. *South African Family Practice*, 65(1): a5655. <https://doi.org/10.4102/safp.v65i1.5655> [Accessed 16 September 2023]

Hack-Polay, D., Mahmoud, A.B., Ikafa, I., Rahman, M., Kordowicz, M. & Verde, J.M. 2023. Steering resilience in nursing practice: Examining the impact of digital innovations and enhanced emotional training on nursing competencies. *Technovation*, 120(C).
<https://doi.org/10.1016/j.technovation.2022.102549> [Accessed 31 May 2023]

Haddad, L.M., Annamaraju, P & Toney-Butler, T.J. 2023. Nursing Shortage. [Updated 2023 Feb 13]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK493175/>

Haider, S., Flynn, A. & Simpson, J.E. 2024. Attitude and readiness of utilizing virtual reality simulations in interprofessional education to facilitate prompt and safe hospital discharges in England. *Social Work Education*, 1–17. <https://doi.org/10.1080/02615479.2024.2336105> [Accessed 12 September 2024]

Haimi, M. 2023. The tragic paradoxical effect of telemedicine on healthcare disparities- a time for redemption: a narrative review. *BMC Medical Informatics and Decision Making*, 23(1):95.
<https://doi.org/10.1186/s12911-023-02194-4> [Accessed 15 October 2023]

Hajizadeh, A., Zamanzadeh, V., Kakemam, E., Bahreini, R. & Khodayari-Zarnaq, R. 2021. Factors influencing nurses' participation in the health policy-making process: a systematic review. *BMC Nursing*, 20(1):128. <https://doi.org/10.1186/s12912-021-00648-6> [Accessed 15 October 2023]

Håkansson Lindqvist, M., Mozelius, P., Jaldemark, J. & Cleveland Innes, M. 2023. Higher education transformation towards lifelong learning in a digital era – a scoping literature review. *International Journal of Lifelong Education*, 43(1):24–38.
<https://doi.org/10.1080/02601370.2023.2279047> [Accessed 24 September 2024]

Hakim, A., White, B., Hamdy, H. & Taren, D. 2019. Impact of the Fourth Industrial Revolution on the Health Sector: A Qualitative Study. *Healthcare Informatics Research*, 26(4):328-334.
<https://doi.org/10.4258/hir.2020.26.4.328> [Accessed 24 September 2023]

Haleem, A., Javaid, M. & Singh, R.P. 2024. Exploring the competence of ChatGPT for customer and patient service management. *Intelligent Pharmacy*, 2(3):392-414.
<https://doi.org/10.1016/j.ipha.2024.03.002> [Accessed 15 July 2024]

Haleem, A., Javaid, M., Qadri, M.A. & Suman, R. 2022. Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, (3):275-285.
<https://doi.org/10.1016/j.susoc.2022.05.004> [Accessed 15 November 2023]

Haleem, A., Javaid, M., Singh, R.P. & Suman, R. 2021a. Telemedicine for healthcare: Capabilities, features, barriers, and applications. *Sensor International*, 2:100117. <https://doi:10.1016/j.sintl.2021.100117> [Accessed 13 June 2024]

Haleem, A., Javaid, M., Singh, R.P. & Suman, R. 2021b. Medical 4.0 technologies for healthcare: Features, capabilities, and applications. *Internet of Things and Cyber-Physical Systems*, 2:12-30. <https://doi.org/10.1016/j.iotcps.2022.04.001> [Accessed 30 May 2023]

Hallaran, A.J., Edge, D.S., Almost, J. & Tregunno, D. 2023. New Nurses' Perceptions on Transition to Practice: A Thematic Analysis. *Canadian Journal of Nursing Research*, 55(1):126-136. <https://doi:10.1177/08445621221074872> [Accessed 5 September 2023]

Handa, A., Gaidhane, A. & Choudhari, S.G. 2024. Role of Robotic-Assisted Surgery in Public Health: Its Advantages and Challenges. *Cureus*, 16(6): e62958. <https://doi:10.7759/cureus.62958> [Accessed 20 August 2024]

Haltaufderheide, J. & Ranisch, R. 2024. The ethics of ChatGPT in medicine and healthcare: a systematic review on Large Language Models (LLMs). *npj Digital Medicine*, 7:183. <https://doi.org/10.1038/s41746-024-01157-x> [Accessed 15 July 2024]

Hammarén, M., Pölkki, T. & Kanste, O. 2024. The management of digital competence sharing in health care: A qualitative study of managers' and professionals' views. *Journal of Advanced Nursing*, 80:2051–2064. <https://doi.org/10.1111/jan.15963> [Accessed 10 July 2024]

Hammerton, M., Benson, T. & Sibley, A. 2022. Readiness for five digital technologies in general practice: perceptions of staff in one part of southern England. *BMJ Open Quality*, 11: e001865. <https://doi:10.1136/bmjopen-2022-001865> [Accessed 11 November 2023]

Hanaysha, J.R., Shriedeh, F.B. & In'airat, M. 2023. Impact of classroom environment, teacher competency, information and communication technology resources, and university facilities on student engagement and academic performance. *International Journal of Information Management Data Insights*, 3(2):100188. <https://doi.org/10.1016/j.ijime.2023.100188> [Accessed 8 January 2023]

Hannawa, A.F., Wu, A.W., Kolyada, A., Potemkina, A. & Donaldson, L.J. 2022. The aspects of healthcare quality that are important to health professionals and patients: A qualitative study. *Patient Education and Counseling*, 105(6):1561-1570. <https://doi.org/10.1016/j.pec.2021.10.016> [Accessed 13 June 2024]

Hardani, H., Sahbany, S., Hadi, S., Ulandari, A.S., Ariwidiani, N.N & Supinganto, A. 2024. Coaching clinic research proposal writing: A practical guide to your research success. *Journal of Community Service and Empowerment*, 5(2):346–353. <https://doi.org/10.22219/jcse.v5i2.32409> [Accessed 20 July 2024]

Harerimana, A., Duma, S.E. & Mtshali, N.G. 2022. First-year nursing students' digital literacy: A cross-sectional study. *Journal of Nursing Education and Practice*, 13(1):31-37. <https://doi.org/10.5430/jnep.v13n1p3.1> [Accessed 24 September 2023]

Harerimana, A. & Mtshali, N.G. 2021. Using Mobile Technologies Among Undergraduate Nursing Students for Academic Purposes in Tertiary Education: A Quantitative Survey. *Computer Informatics Nursing*, 39(5):257-264. <https://doi:10.1097/CIN.0000000000000694> [Accessed 18 January 2024]

- Harerimana, A., Wicking, K., Biedermann, N. & Yates, K. 2021. Integrating nursing informatics into undergraduate nursing education in Africa: A scoping review. *International nursing review*, 68(3):420–433. <https://doi.org/10.1111/inr.12618> [Accessed 13 August 2022]
- Harerimana, A. & Mtshali, N.G. 2020. Using Exploratory and Confirmatory Factor Analysis to understand the role of technology in nursing education. *Nurse Education Today*, 92:104490. <https://doi.org/10.1016/j.nedt.2020.104490> [Accessed 12 August 2021]
- Harerimana, A. & Mtshali, NG. 2019. "Nursing Students' Perceptions and Expectations Regarding the Use of Technology in Nursing Education". *Africa Journal of Nursing and Midwifery*, 21(2):20 <https://doi.org/10.25159/2520-5293/5103> [Accessed 15 October 2022]
- Harerimana, A. & Mtshali, NG. 2018. Internet usage among undergraduate nursing students: A case study of a selected university in South Africa. *Journal of Nursing Education and Practice*, 8(8):75-96. <https://doi.org/10.5430/jnep.v8n8p75> [Accessed 17 September 2022]
- Hariguna, T., Ruangkanjanases, A., Madon, B.B. & Alfawaz, K.M. 2023. Assessing Determinants of Continuance Intention Toward Cryptocurrency Usage: Extending Expectation Confirmation Model with Technology Readiness. *SAGE Open*, 13:215824402311604. <https://doi.org/10.1177/21582440231160439> [Accessed 6 September 2023]
- Hariyati, R.T.S., Handiyani, H., Zaharany, T.A., Merduaty, R.C., Wildani, A.A., Rachmi, S.F., Gayatri, D., Rahman, L.A. & Kobayashi, N. 2024. Digital nursing promotion has increased ethics digital literacy: Program improvement [version 1; peer review: 1 approved with reservations]. *F1000Research*, 13:366. <https://doi.org/10.12688/f1000research.139211.1> [Accessed 20 August 2024]
- Harris, M.T., Statler, M.C., Montague, E., Oduor, K. & Stonewall, J. 2024. Identifying and reducing barriers to having a racially and ethnically diverse research population, *International Journal of Industrial Ergonomics*, 99:103527. <https://doi.org/10.1016/j.ergon.2023.103527> [Accessed 15 July 2024]
- Harvey, O., van Teijlingen, E. & Parrish, M. 2024. Using a Range of Communication Tools to Interview a Hard-to-Reach Population. *Sociological Research Online*, 29(1):221-232. <https://doi.org/10.1177/13607804221142212> [Accessed 15 July 2024]
- Hasan, K. 2024. Quantitative Methods in Social Science Research: Systematic Review of Content Analysis, Survey and Experiment Methodologies. Available at *SSRN Electronic Journal*. <http://dx.doi.org/10.2139/ssrn.4698175> [Accessed 15 July 2024]
- Hassan, M. 2023. Descriptive Statistics – Types, Methods and Examples. <https://researchmethod.net/descriptive-statistics/> [Accessed 22 September 2023]
- Havard, M., Whistance, M., Johns, G., Drew, S., Cusens, C., Thomas, S., Khalil, S., Ogonovsky, M. & Ahuja, A. 2024. Defining digital nursing. *British Journal of Nursing*, 33(2). <https://doi.org/10.12968/bjon.2024.33.2.72> [Accessed 15 July 2024]
- Hernon, O., McSharry, E., MacLaren, I. & Carr, P.J. 2023. The use of educational technology in teaching and assessing clinical psychomotor skills in nursing and midwifery education: A state-of-the-art literature review. *Journal of Professional Nursing*, (45):35-50. <https://doi.org/10.1016/j.profnurs.2023.01.005> [Accessed 17 September 2023]

Heroes, A. K., Devoogdt, N., Damstra, R. J., Fourneau, I., Gordon, K., Keeley, Thomis, Van Calster, Van Zanten & De Vrieze, 2024. Reliability, concurrent validity, and clinical feasibility of measurement methods determining volume in patients with lower limb lymphedema and healthy controls. *Disability and Rehabilitation*, 1–15. <https://doi.org/10.1080/09638288.2024.2374482> [Accessed 20 July 2024]

Heydrich, S., Schroeder, R. & Velten, S. 2020. Collaborative duty rostering in health care professions. *Operations Research for Health Care*, 27:100278. <https://doi.org/10.1016/j.orhc.2020.100278> [Accessed 31 May 2023]

Heo, C.Y., Kim, B., Park, K. Back, R.M. 2022. A comparison of Best-Worst Scaling and Likert Scale methods on peer-to-peer accommodation attributes. *Journal of Business Research*, 148:368-377. <https://doi.org/10.1016/j.jbusres.2022.04.064> [Accessed 30 August 2023]

Herington, J., Li, K. & Pisani, A.R. 2024. Expanding the role of justice in secondary research using digital psychological data. *American Psychologist*, 79(1):123–136. <https://doi.org/10.1037/amp0001190> [Accessed 20 July 2024]

Hiebl, M.R. 2023. Sample selection in systematic literature reviews of management research. *Organizational research methods*, 26(2):229-261. <https://doi.org/10.1177/1094428120986851> [Accessed 15 October 2023]

High, M. 2025. Deep Research: Inside OpenAI's New Analysis Tool. <https://aimagazine.com/ai-applications/deep-research-inside-openais-new-analysis-tool> [Accessed 16 March 2025]

Hijón-Neira, R., Pizarro, C., French, J., Palacios-Alonso, D. & Çoban, E. 2024. Computational Thinking Measurement of CS University Students. *Applied Sciences*, 14(12):5261. <https://doi.org/10.3390/app14125261> [Accessed 20 July 2024]

Ho, Y.R., Chen, B.Y. & Li, C.M. 2023. Thinking more wisely: using the Socratic method to develop critical thinking skills amongst healthcare students. *BMC Medical Education*, 23:173. <https://doi.org/10.1186/s12909-023-04134-2> [Accessed 28 March 2023]

Hoang, T.V. 2024. Impact of Integrated Artificial Intelligence and Internet of Things Technologies on Smart City Transformation. *Journal of Technical Education Science*, 19(Special Issue 01):64–73. <https://doi.org/10.54644/jte.2024.1532> [Accessed 14 July 2024]

Holland Brown, T.M. & Bewick, M. 2023. Digital health education: the need for a digitally ready workforce. *Archives of Disease in Childhood – Education and Practice*, 108(3):214-217. <https://doi.org/10.1136/archdischild-2021-322022> [Accessed 15 October 2023]

Hooper, V. 2023. Nursing Post Pandemic: The Path Forward. *Journal of Perianesthesia Nursing*, 38(1):1-2. <https://doi.org/10.1016/j.jopan.2022.12.001> [Accessed 14 September 2023]

Holtom, B., Baruch, Y., Aguinis, H. & Ballinger, G. 2022a. Survey response rates: Trends and a validity assessment framework. *Human Relations*, 75(8):1560–1584. <https://doi.org/10.1177/00187267211070769> [Accessed 14 February 2023]

Holtom, B., Baruch, Y., Aguinis, H. & A Ballinger, G. 2022b. Survey response rates: Trends and a validity assessment framework. *Human Relations*, 75(8):1560-1584. <https://doi.org/10.1177/00187267211070769> [Accessed 20 September 2020]

Horwood, C., Luthuli, S., Mapumulo, S., Haskins, L., Jensen, C., Pansegrouw, D. & McKerrow, N. 2023. Challenges of using e-health technologies to support clinical care in rural Africa: a

longitudinal mixed methods study exploring primary health care nurses' experiences of using an electronic clinical decision support system (CDSS) in South Africa. *BMC Health Services Research*, 23:30. <https://doi.org/10.1186/s12913-022-09001-2> [Accessed 17 September 2023]

Howarth, J. 2023. Generation Alpha: Statistics, Data and Trends. <https://explodingtopics.com/blog/generation-alpha-stats> [Accessed 15 September 2023]

Hunziker, S. & Blankenagel, M. 2024. Multiple Case Research Design. In: Research Design in Business and Management. Springer Gabler, Wiesbaden. https://doi.org/10.1007/978-3-658-42739-9_9 [Accessed 15 July 2024]

Huter, K., Krick, T., Domhoff, D., Seibert, K., Wolf-Ostermann, K. & Rothgang, H. 2020. Effectiveness of Digital Technologies to Support Nursing care: Results of a Scoping Review. *Journal of Multidisciplinary Healthcare*, 13:1905-19260. <https://doi.org/10.2147/JMDH.S286193> [Accessed 13 July 2021]

Huai, P., Li, Y., Wang, X., Zhang, L., Liu, N. & Yang, H. 2024. The effectiveness of virtual reality technology in student nurse education: A systematic review and meta-analysis. *Nurse Education Today*, 138:106189. <https://doi.org/10.1016/j.nedt.2024.106189> [Accessed 15 June 2024]

Husain, H., Aziz, H., Hussain, A., Afthanorhan, A. & Bin Chik, Z. 2024. Exploratory Factor Analysis and Confirmatory Factor Analysis of Historical Thinking Skills (HTS) Component: Determining Dimensionality, Validity, and Reliability of HTS Items Among Islamic Education Teachers. *International Research Journal of Multidisciplinary Scope (IRJMS)*, 5(1):301-316. <https://doi:10.47857/irjms.2024.v05i01.0211> [Accessed 15 July 2024]

Hwang, K., Williams, S., Zucchi, E., Chong, T.W.H., Mascitti-Meuter, M., LoGiudice, D., Goh, A.M.Y., Panayiotou, A. & Batchelor, F. 2022. Testing the use of translation apps to overcome everyday healthcare communication in Australian aged-care hospital wards-An exploratory study. *Nursing Open*, 9(1):578-585. <https://doi:10.1002/nop2.1099> [Accessed 13 June 2024]

Ibuki, T., Ibuki, A. & Nakazawa, E. 2023. Possibilities and ethical issues of entrusting nursing tasks to robots and artificial intelligence. *Nursing Ethics*, 12:9697330221149094. <https://doi:10.1177/09697330221149094> [Accessed 17 September 2023]

Hyseni Duraku, Z., Jemini-Gashi, L. & Toçi, E. 2020. Perceptions of Early Marriage, Educational Aspirations, and Career Goals among Kosovar Adolescents. *Marriage & Family Review*, 56(6):513–534. <https://doi.org/10.1080/01494929.2020.1728006> [Accessed 16 September 2023]

Idriss, K.N., Mohamad Ikram, I., Norsarwany, M. & Taib, F. 2024. The development and pretesting of attitude and practice questionnaire on ethical decision-making during a pandemic among paediatric healthcare professionals in Malaysia. *Education in Medicine Journal*, 16(1):57–73. <https://doi.org/10.21315/eimj2024.16.1.5> [Accessed 18 July 2024]

Ifrim, R.A., Klugarová, J., Măguriță, D., Zazu, M., Mazilu, D.C. & Klugar, M. 2022. Communication, an important link between healthcare providers: a best practice implementation project. *JBI Evidence Implementation*, 20(S1): S41-S48. <https://doi.org/10.1097/XEB.0000000000000319> [Accessed 30 August 2023]

Iftikhar, M., Saqib, M., Zareen, M. & Mumtaz, H. 2024. Artificial intelligence: revolutionizing robotic surgery: review. *Annals of Medicine & Surgery*, 0(00). <https://doi:10.1097/MS9.0000000000002426> [Accessed 20 August 2024]

Ikart, E.M. 2019. Survey Questionnaire Survey Pretesting Method: An Evaluation of Survey Questionnaire via Expert Reviews Technique. *Asian Journal of Social Science Studies*, 4(2). <https://doi.org/10.20849/ajsss.v4i2.565> [Accessed 19 July 2024]

Irwin, P., Hanson, M., McDonald, S., Noble, D. & Mollart, L. 2024. Nursing students' perspectives on being work-ready with electronic medical records: Intersections of rurality and health workforce capacity. *Nurse Education in Practice*, 77:103948. <https://doi.org/10.1016/j.nepr.2024.103948> [Accessed 15 July 2024]

Isidori, V., Diamanti, F., Gios, L., Malfatti, G., Perini, F., Nicolini, A., Longhini, J., Forti, S., Fraschini, F., Bizzarri, G., Brancorsini, S & Gaudino, A. 2022. Digital Technologies and the Role of Health Care Professionals: Scoping Review Exploring Nurses' Skills in the Digital Era and in the Light of the COVID-19 Pandemic. *Journal of Medical Internet Research Nursing*, 5(1): e37631. <https://nursing.jmir.org/2022/1/e37631> [Accessed 27 May 2023]

Islam, M.N., Mim, S.T., Tasfia, T. & Hossain, M.M. 2024. Enhancing patient treatment through automation: The development of an efficient scribe and prescribe system, *Informatics in Medicine Unlocked*, 45:101456. <https://doi.org/10.1016/j.imu.2024.101456> [Accessed 14 July 2024]

Istepanian, R.S.H. 2022. Mobile Health (m-Health) in Retrospect: The Known Unknowns. *International Journal of Environmental Research and Public Health*, 19(7):3747. <https://doi:10.3390/ijerph19073747> [Accessed 24 September 2024]

Iyanna, S., Kaur, P., Ractham, P., Talwar, S. & Najmul Islam, A.K.M. 2022. Digital transformation of healthcare sector. What is impeding adoption and continued usage of technology-driven innovations by end-users? *Journal of Business Research*, 153:150-161. <https://doi.org/10.1016/j.jbusres.2022.08.007> [Accessed 22 June 2024]

Jäckel, E., Zerres, A. & Hüffmeier, J. 2024. Active Listening in Integrative Negotiation. *Communication Research*, 0(0). <https://doi.org/10.1177/00936502241230711> [Accessed 18 July 2024]

Jadalla, A., Hardan-Khalil, K., Dyo, M., Kardously, J., Skaff, K. & Williams, M. 2024. The perceived preparedness of prelicensure nursing students to transition to practice. *Teaching and Learning in Nursing*, 19(3):260-264. <https://doi.org/10.1016/j.teln.2024.04.001>. [Accessed 14 July 2024]

Jakoet-Salie, A. & Ramalobe, K. 2023. The digitalization of learning and teaching practices in higher education institutions during the Covid-19 pandemic. *Teaching Public Administration*, 41(1):59–71. <https://doi.org/10.1177/01447394221092275> [Accessed 5 September 2023]

Jamieson, S. 2024. Likert scale. Encyclopedia Britannica. <https://www.britannica.com/topic/Likert-Scale> [Accessed 14 June 2024]

Janjua, S., Carter, D., Threapleton, C.J., Prigmore, S. & Disler, R.T. 2021. Telehealth interventions: remote monitoring and consultations for people with chronic obstructive pulmonary disease (COPD). *Cochrane Database of Systemic Reviews*, 7(7):CD013196. <https://doi:10.1002/14651858.CD013196> [Accessed 11 November 2023]

Jankelová, N. & Joniaková, Z. 2021. Communication Skills and Transformational Leadership Style of First-Line Nurse Managers in Relation to Job Satisfaction of Nurses and Moderators of

This Relationship. *Healthcare*, 9(3):346. <https://doi.org/10.3390/healthcare9030346> [Accessed 13 June 2024]

Jansen, D. & Warren, K. 2020. Quantitative Data Analysis 101: The lingo, methods and techniques, explained simply. www.gradcoach.com. *Quantitative Data Analysis Methods & Techniques 101 - Grad Coach*. [Accessed 20 May 2023]

Javaid, M., Haleem, A., Singh, R.P. & Suman, R. 2021. Substantial capabilities of robotics in enhancing industry 4.0 implementation. *Cognitive Robotics*, 1:58-75. <https://doi.org/10.1016/j.cogr.2021.06.001> [Accessed 5 September 2023]

Javaid, M., Haleem, A., Singh, R.P., Rab, S., Suman, R. & Khan, I.H. 2022. Evolutionary trends in progressive cloud computing-based healthcare: Ideas, enablers, and barriers. *International Journal of Cognitive Computing in Engineering*, (3):124-135. <https://doi.org/10.1016/j.ijcce.2022.06.001> [Accessed 5 June 2023]

Jayousi, S., Barchielli, C., Alaimo, M., Caputo, S., Paffetti, M., Zoppi, P. & Mucchi, L. 2024. ICT in Nursing and Patient Healthcare Management: Scoping Review and Case Studies. *Sensors (Basel)*, 24(10):3129. <https://doi.org/10.3390/s24103129> [Accessed 24 July 2024]

Jedwab, R.M., Manias, E., Redley, B., Dobroff, N. & Hutchinson, A.M. 2023. Impacts of technology implementation on nurses' work motivation, engagement, satisfaction and well-being: A realist review. *Journal of Clinical Nursing*, 32:6037–6060. <https://doi.org/10.1111/jocn.16730> [Accessed 22 June 2024]

Jeffries, P.R., Bushardt, R.L., DuBose-Morris, R., Hood, C., Kardong-Edgren, S., Pintz, C., Posey, L. & Sikka, N. 2022. The Role of Technology in Health Professions Education During the COVID-19 Pandemic. *Academic Medicine*, 97(3S):S104-S109. <https://doi.org/10.1097/ACM.0000000000004523> [Accessed 22 September 2024]

Jerath, K.S. 2021. The First and Second Industrial Revolution. In: Science, Technology and Modernity. Springer, Cham. https://doi.org/10.1007/978-3-030-80465-7_6 [Accessed 10 March 2023]

Jha, A. (2020). Understanding Generation Alpha. <https://10.31219/osf.io/d2e8g> [Accessed 10 June 2024]

Jobst, S., Lindwedel, U., Marx, H., Pazouki, R., Ziegler, S., König, P., Kugler, C. & Feuchtinger, J. 2022. Competencies and needs of nurse educators and clinical mentors for teaching in the digital age – a multi-institutional, cross-sectional study. *BMC Nursing*, 21:240. <https://doi.org/10.1186/s12912-022-01018-6> [Accessed 21 June 2024]

Johari, S., Ismail, W.M. & Salleh, U.K.M. 2024. The Importance of Appropriate Implementation of Essential Skills, Clinical Supervision, And Competency Skills Among Nursing Students in Providing Nursing Care – A Conceptual Framework. *Educational Administration: Theory and Practice*, 30(5):12027–12032. <https://doi.org/10.53555/kuey.v30i5.5059> [Accessed 14 July 2024]

Johnson, J.L., Adkins, D. & Chauvin, S. 2020. A Review of the Quality Indicators of Rigor in Qualitative Research. *American Journal of Pharmaceutical Education*, 1:7120. <https://doi.org/10.5688/ajpe7120> [Accessed 23 May 2023]

Jokinen, H., Pramila-Savukoski, S., Kuivila, H.M., Jämsä, R., Juntunen, J., Törmänen, T., Koskimäki, M. & Mikkonen, K. 2024. Development and psychometric testing of hybrid education

competence instrument for social and health care, and health sciences educators. *Nurse Education Today*, 132:105999. <https://doi.org/10.1016/j.nedt.2023.105999> [Accessed 15 July 2024]

Jongsma, K.R., Bekker, M.N., Haitjema, S. & Bredenoord, A.L. 2021. How digital health affects the patient-physician relationship: An empirical-ethics study into perspectives and experiences in obstetric care. *Pregnancy Hypertension*, 25:81-86. <https://doi.org/10.1016/j.pregphy.2021.05.017> [Accessed 22 June 2024]

Jordan, R., Watowicz, R.P., King, C., Phillips, C., Obeid, R. & Hand, R.K. 2024. Preliminary content and construct validity of a new model to differentiate research skills from evidence-based practice skills: Core, Evidence Application, Research (CEAR) Model. *Journal of Human Nutrition and Dietetics*, 37(2):440-458. <https://doi.org/10.1111/jhn.13266> [Accessed 20 July 2024]

Jordan, M. 2023. The power of connection: Self-care strategies for social wellbeing. *Journal of Interprofessional Education & Practice*, 31:100586. <https://doi.org/10.1016/j.xjep.2022.100586> [Accessed 13 June 2024]

Judijanto, L., Putra, N.H., Zani, N.B., Hasyim, M.D. & Muntasir, M. 2024. E-Health and Digital Transformation in Increasing Accessibility of Health Services. *Journal of World Future Medicine, Health and Nursing*, 2(1):119-132. <https://doi.org/10.70177/health.v2i1.720> [Accessed 20 August 2024]

Junaid, S.B., Imam, A.A., Balogun, A.O., De Silva, L.C., Surakat, Y.A., Kumar, G., Abdulkarim, M., Shuaibu, A.N., Garba, A., Sahalu, Y., Mohammed, A., Mohammed, T.Y., Abdulkadir, B.A., Abba, A.A., Kakumi, N.A.I. & Mahamad, S. 2022. Recent Advancements in Emerging Technologies for Healthcare Management Systems: A Survey. *Healthcare*, 10(10):1940. <https://doi:10.3390/healthcare10101940> [Accessed 22 June 2024]

Kaihlanen, A.M., Laukka, E., Nadav, J., Närvänen, J., Saukkonen, P., Koivisto, J. & Heponiemi, T. 2023. The effects of digitalisation on health and social care work: a qualitative descriptive study of the perceptions of professionals and managers. *BMC Health Services Research*, 23:714. <https://doi.org/10.1186/s12913-023-09730-y> [Accessed 4 September 2023]

Kakilla, C. 2021. Strengths and Weaknesses of Semi-Structured Interviews in Qualitative Research: A Critical Essay. <https://doi.org/10.20944/preprints202106.0491.v1> [Accessed 14 February 2023]

Kalariya, K., Chauhan, R., Soni, P., Patel, M. & Patel, H. 2024. Unraveling Millennial Online Shopping Preferences: A Comprehensive Analysis of Factors Influencing Consumer Behaviour in the Digital Marketplace. *Journal of Business and Halal Industry*, 1(4):1–12. <https://doi.org/10.47134/jbhi.v1i4.294> [Accessed 24 July 2024]

Kaleem, M.M., Azeem, M., Idrees, S. & Muhammad, T. 2024. Comparison of Generation X and Generation Y for Leadership Style Preference with the Moderating Role of Legacy Beliefs. *Journal of Asian Development Studies*, 13(2):24-39. <https://doi.org/10.62345/jads.2024.13.2.3> [Accessed 20 July 2024]

Kaliyadan, F. & Kulkarni, V. 2019. Types of Variables, Descriptive Statistics, and Sample Size. *Indian Dermatology Online Journal*, 10(1):82-86. https://doi:10.4103/idoj.IDOJ_468_18 [Accessed 13 June 2024]

- Kamerer, J & McDermott, D. 2020. Cybersecurity: Nurses on the Front Line of Prevention and Education. *Journal of Nursing Regulation*, 10(4):8-53. [https://doi.org/10.1016/S2155-8256\(20\)30014-4](https://doi.org/10.1016/S2155-8256(20)30014-4) [Accessed 28 March 2023]
- Kamińska, D., Zwoliński, G., Laska-Leśniewicz, A., Raposo, R., Vairinhos, M., Pereira, E., Urem, F., Ljubić Hinić, M., Haamer, R.E. & Anbarjafari, G. 2023. Augmented Reality: Current and New Trends in Education. *Electronics*, 12(16):3531. <https://doi.org/10.3390/electronics12163531> [Accessed 24 June 2024]
- Karaca, A., Kaya, G. & Kaya, L. 2023. The relationship between critical thinking skills and caregiving roles of nurses. *Journal of Education and Research in Nursing*, 20(4):360-366. <https://doi:10.14744/jern.2023.22354> [Accessed 24 June 2024]
- Karnehed, S., Erlandsson, L.K. & Norell Pejner, M. 2022. Nurses' Perspectives on an Electronic Medication Administration Record in Home Health Care: Qualitative Interview Study. *JMIR Nursing*, 5(1): e35363. <https://doi:10.2196/35363> [Accessed 22 July 2024]
- Kashiripoor, M.M. 2024. Fourth wave technologies in construction and architecture: from idea to realization (Part 1: Basic understanding, definition and historical events). *Urban Construction and Architecture*, 14(2):133-142. <https://doi:10.17673/Vestnik.2024.02.17> [Accessed 14 July 2024]
- Katsaouni, M., Tripsianis, G., Constantinidis, T., Vadikolias, K., Kontogiorgis, C., Serdari, A., Arvaniti, A., Theodorou, E. & Nena, E. 2024. Assessment of quality of life, job insecurity and work ability among nurses, working either under temporary or permanent terms. *International Journal of Occupational Medicine and Environmental Health*, 37(1):98-109. <https://doi:10.13075/ijomeh> [Accessed 22 July 2024]
- Katsoulakis, E., Wang, Q., Wu, H., Shahriyari, L., Fletcher, R., Liu, J., Achenie, L., Liu, H., Jackson, P., Xiao, Y., Syeda-Mahmood, T., Tuli, R. & Deng, J. 2024. Digital twins for health: a scoping review. *npj Digital Medicine*, 7(77). <https://doi.org/10.1038/s41746-024-01073-0> [Accessed 24 June 2024]
- Kavanagh, J.M. & Sharpnack, P.A. 2021. "Crisis in Competency: A Defining Moment in Nursing Education" *OJIN: The Online Journal of Issues in Nursing*, 26(1):2. <https://doi.10.3912/OJIN.Vol26No01Man02> [Accessed 14 October 2023]
- Keerthana, G., Indrapriyadharshini, K., Subraman, V.P., Keerthana, S., Jagadeson, M., Ravi, K & Revanth, M.P. 2024. Assessment of Knowledge, Practice, and Perception about social media in Dentistry among Dental Students at Chengalpattu District: A Cross-sectional Study. *Journal of Primary Care Dentistry and Oral Health*, 5(2):74-78. https://doi:10.4103/jpcdoh.jpcdoh_13_24 [Accessed 20 July 2024]
- Kelle, N., Simonson, J. & Henning, G. 2024. Baby Boomers and Their Voluntary Engagement: A Cohort Comparison Among the Middle-Aged and Older Population in Germany. *Nonprofit and Voluntary Sector Quarterly*, 0(0). <https://doi.org/10.1177/08997640241240417> [Accessed 15 July 2024]
- Keong, Y., Md Husin, M. & Kamarudin, S. 2023. Understanding Research Paradigms: A Scientific Guide. *Journal of Contemporary Issues in Business and Government*, 27(2). <https://doi.10.47750/cibg.2021.27.02.588> [Accessed 13 June 2024]

- Kerimbayev, N., Umirzakova, Z., Shadiev, R. & Jotsov, V. 2023. A student-centered approach using modern technologies in distance learning: a systematic review of literature. *Smart Learning Environments*, 10(61). <https://doi.org/10.1186/s40561-023-00280-8> [Accessed 22 June 2024]
- Keshta, I & Odeh, A. 2021. Security and privacy of electronic health records: Concerns and challenges. *Egyptian Informatics Journal*, (2):177-183. <https://doi.org/10.1016/j.eij.2020.07.003> [Accessed 22 May 2023]
- Khaled, S.M., Amro, I., Bader, L., Lee Holmes, J., Le Trung, K. & Diop, A. 2024. Qatar's National Mental Health Survey—The World Mental Health Qatar: Sampling design, instrument adaptation, quality control, and fielding procedures. *International Journal of Methods in Psychiatric Research*, e2010. <https://doi.org/10.1002/mpr.2010> [Accessed 18 July 2024]
- Khalil, A.I., Hantira, N.Y. & Alnajjar, H.A. 2023. The Effect of Simulation Training on Enhancing Nursing Students' Perceptions to Incorporate Patients' Families into Treatment Plans: A Randomized Experimental Study. *Cureus*, 15(8): e44152. <https://doi:10.7759/cureus.44152> [Accessed 22 July 2024]
- Khanday, S. & Khanam, D. 2023. THE RESEARCH DESIGN. 06:376. https://www.researchgate.net/publication/368257495_THE_RESEARCH_DESIGN/citation/download [Accessed 14 October 2023]
- Khanuja, A., Sreedharan, R. and Sharma, N. 2024. "Bibliometric analysis on usage of Industry 4.0 technologies in healthcare". *The TQM Journal*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/TQM-08-2023-0252> [Accessed 14 July 2024]
- Khogali, H.O. & Mekid, S. 2023. The blended future of automation and AI: Examining some long-term societal and ethical impact features. *Technology in Society*, 73:102232. <https://doi.org/10.1016/j.techsoc.2023.102232> [Accessed 5 September 2023]
- Khosravi, M., Zare, Z., Mojtabaeian, S.M. & Izadi, R. 2024. Artificial Intelligence and Decision-Making in Healthcare: A Thematic Analysis of a Systematic Review of Reviews. *Health Services Research and Managerial Epidemiology*, 11:23333928241234863. <https://doi:10.1177/23333928241234863> [Accessed 29 May 2024]
- Khoza, T.K., Mabitsela, T. & Nel, P. 2024. Technology readiness, technology acceptance, and work engagement: A mediational analysis. *SA Journal of Industrial Psychology*, 50(1). https://hdl.handle.net/10520/ejc-psyc_v50_n1_a2131 [Accessed 14 July 2024]
- Khraisat, O.M.A., Al-Bashaireh, A.M. & Alnazly, E. 2023. Telenursing implications for future education and practice: Nursing students' perspectives and knowledge from a course on child health. *PLoS One*, 18(11): e0294711. <https://doi:10.1371/journal.pone.0294711> [Accessed 12 June 2024]
- Khurana, D., Koli, A., Khatter, K. & Singh, S. 2023. Natural language processing: state of the art, current trends and challenges. *Multimedia Tools and Applications*, 82:3713–3744. <https://doi.org/10.1007/s11042-022-13428-4> [Accessed 31 May 2023]
- Khurniawan, A.W., Irmawaty. & Supriadi, D. 2024. The impact of digital leadership on digital transformation in university organizations: an analysis of students' views. *Perspektiv nauki i obrazovanja – Perspectives of Science and Education*, 67(1):677-690. <https://doi:10.32744/pse.2024.1.38> [Accessed 20 July 2024]

- Kiegaldie, D. & Shaw, L. 2023. Virtual reality simulation for nursing education: effectiveness and feasibility. *BMC Nursing*, 22(488). <https://doi.org/10.1186/s12912-023-01639-5> [Accessed 24 July 2024]
- Kim, Y. 2024. Quantitative criticalism for social justice and equity-oriented communication research. *Human Communication Research*, 50(2):162–172. <https://doi.org/10.1093/hcr/hqad048> [Accessed 20 July 2024]
- Kim, M. 2023. Effects of a Comprehensive Person-Centered Care Education Program for Nursing Students. *Medicina (Kaunas)*, 59(3):463. <https://doi.org/10.3390/medicina59030463> [Accessed 10 March 2023]
- Kim, Y., Lee, M.J., Choi, M., Cho, E. & Ryu, G.W. 2023. Exploring nurses' multitasking in clinical settings using a multimethod study. *Scientific Reports*, 13(1):5704. <https://doi.org/10.1038/s41598-023-32350-9> [Accessed 14 September 2023]
- Kini, S., Duluk, D. & Weinstein, J. 2023. Modeling the impact of digital readiness in recruiting and sustaining underrepresented groups: Data from the *All of Us* research program. *Frontiers in Digital Health*, 4:1082098. <https://doi.org/10.3389/fdgth.2022.1082098> [Accessed 29 May 2024]
- Kissi, J., Azakpah, G., Mensah, N.K., Dzamvivi, K., Bosompem, T.A., Wireko, V.A. & Amoah-Anomah, G. 2024. Healthcare professionals' perception on emergence of security threat using digital health technologies in healthcare delivery. *DIGITAL HEALTH*, 10. <https://doi.org/10.1177/20552076241260385> [Accessed 10 July 2024]
- Kjellaas, S., Fredheim, G. & Moen, Ø.L. 2020. Registered nurses' experiences with master's degree competence in the specialist health service: A qualitative descriptive study. *Nordic Journal of Nursing Research*, 40(4):221-228. <https://doi.org/10.1177/2057158520946028> [Accessed 15 September 2023]
- Klarin, A., Ali Abadi, H. & Sharmelly, R. 2024. Professionalism in artificial intelligence: The link between technology and ethics. *Systems Research and Behavioral Science*, 41(4):557–580. <https://doi.org/10.1002/sres.2994> [Accessed 18 July 2024]
- Klarin, A. 2024. How to conduct a bibliometric content analysis: Guidelines and contributions of content co-occurrence or co-word literature reviews. *International Journal of Consumer Studies*, 48(2): e13031. <https://doi.org/10.1111/ijcs.13031> [Accessed 15 July 2024]
- Kleib, M., Nagle, L.M., Furlong, K.E., Paul, P., Duarte Wisnesky, U & Ali, S. 2022. Are Future Nurses Ready for Digital Health? Informatics Competency Baseline Assessment. *Nurse Educator*, 47(5): E98-E104. <https://doi.org/10.1097/NNE.0000000000001199> [Accessed 10 June 2024]
- Klimenko, A.Y. 2024. Technological Change and Its Effect on Education. *Journal of Educational and Psychological Research*, 6(1):01-18. <https://dx.doi.org/10.33140/JEPR> [Accessed 22 July 2024]
- Klingberg, S., Stalmeijer, R.E. & Varpio, L. 2023. Using framework analysis methods for qualitative research: AMEE Guide No. 164. *Medical Teacher*, 46(5):603–610. <https://doi.org/10.1080/0142159X.2023.2259073> [Accessed 18 July 2024]

Knekta, E., Runyon, C. & Eddy, S. 2019. One Size Doesn't Fit All: Using Factor Analysis to Gather Validity Evidence When Using Surveys in Your Research. *CBE Life Sciences Education*, 18(1):rm1. <https://doi.org/10.1187/cbe.18-04-0064> [Accessed 29 May 2023]

Knell, M. 2021. The digital revolution and digitalized network society. *Review of Evolutionary Political Economy*, 2:9–25. <https://doi.org/10.1007/s43253-021-00037-4> [Accessed 28 March 2023]

Knop, M., Mueller, M., Kaiser, S. & Rester, C. 2024. The impact of digital technology use on nurses' professional identity and relations of power: a literature review. *Journal of Advanced Nursing*, 00:1–15. <https://doi.org/10.1111/jan.16178> [Accessed 24 July 2024]

Knowles, L.M., Grewal, M., Drever, S.A., Hoffman, J.M., Friedly, J.L. & Herring, T.E. 2024. A pilot randomized controlled trial of a telemedicine psychosocial intervention to improve symptom management in adults with long COVID: the COPE study protocol. *Pilot and Feasibility Studies*, 10:93. <https://doi.org/10.1186/s40814-024-01515-2> [Accessed 10 June 2024]

Kodama, F. 2018. Learning Mode and Strategic Concept for the 4th Industrial Revolution. *Journal of Open Innovation: Technology, Market, and Complexity*, 4(3):32. <https://doi.org/10.3390/joitmc40300> [Accessed 13 August 2022]

Kobekyaa, F. & Naidoo, J.R. 2023. 'Collaborative clinical facilitation in selected nursing and midwifery colleges in Northern Ghana'. *Health SA Gesondheid*, 28(0): a2121. <https://doi.org/10.4102/hsag.v28i0.2121> [Accessed 10 June 2024]

Koebe, P. & Bohnet-Joschko, S. 2023. The Impact of Digital Transformation on Inpatient Care: Mixed Methods Study. *JMIR Public Health and Surveillance*, 9: e40622. <https://doi.org/10.2196/40622> [Accessed 17 September 2023]

Kohler, U., Class, F. & Sawert, T. 2023. Control variable selection in applied quantitative sociology: a critical review. *European Sociological Review*, jcac078. <https://doi.org/10.1093/esr/jcac078> [Accessed 7 October 2023]

Kooli, C. 2023. Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions. *Sustainability*, 15(7):5614. <https://doi.org/10.3390/su15075614> [Accessed 22 September 2023]

Kornelsen, J., Khowaja, A.R., Av-Gay, G., Sullivan, E., Parajulee, A., Dunnebacke, M., Egan, D., Balas, M. & Williamson, P. 2021. The rural tax: comprehensive out-of-pocket costs associated with patient travel in British Columbia. *BMC Health Services Research*, 21:854. <https://doi.org/10.1186/s12913-021-06833-2> [Accessed 5 June 2023]

Kosie, J.E. & Lew-Williams, C. 2024. Open Science Considerations for Descriptive Research in Developmental Science. *Infant and Child Development*, 33(1): e2377. <https://doi.org/10.1002/icd.2377> [Accessed 18 July 2024]

Kosmas, P., Nisiforou, E. & Vrasidas, C. 2024. TRANSFORMING HIGHER EDUCATION TEACHING THROUGH THE INTEGRATION OF VIRTUAL AND AUGMENTED REALITY. *INTED2024 Proceedings*, 2604-2612. <https://doi.org/10.21125/inted.2024.0728> [Accessed 10 July 2024]

- Koudouridis, G.P., Shalmashi, S. & Moosavi, R. 2024. An Evaluation Survey of Knowledge-Based Approaches in Telecommunication Applications. *Telecom*, 5(1):98-121. <https://doi.org/10.3390/telecom5010006> [Accessed 15 July 2024]
- Koukourikos, K., Tsaloglidou, A., Kourkouta, L., Papathanasiou, I.V., Iliadis, C., Fratzana, A. & Panagiotou, A. 2021. Simulation in Clinical Nursing Education. *Acta Informatica Media*, 29(1):15-20. <https://doi:10.5455/aim.2021.29.15-20> [Accessed 22 September 2024]
- Kraus, S., Bouncken, R.B. & Yela Aránega, A. 2024. The burgeoning role of literature review articles in management research: an introduction and outlook. *Review of Managerial Science*, 18:299–314. <https://doi.org/10.1007/s11846-024-00729-1> [Accessed 10 June 2024]
- Krause, K., Schnitzler, T. 2022. Challenges Arising from Rapid Technological Change. In: Business Partner Management. Springer, Wiesbaden. https://doi.org/10.1007/978-3-658-37475-4_6 [Accessed 28 March 2023]
- Krick, T., Huter, K., Domhoff, D., Schmidt, A., Rothgang, H. & Wolf-Ostermann, K. 2019. Digital technology and nursing care: a scoping review on acceptance, effectiveness and efficiency studies of informal and formal care technologies. *BMC Health Services Research*, 19(1):400. <https://doi.org/10.1186/s12913-019-4238-3> [Accessed 11 October 2023]
- Krishnan, G., Singh, S., Pathania, M., Gosavi, S., Abhishek, S., Parchani, A. & Dhar, M. 2023. Artificial intelligence in clinical medicine: catalysing a sustainable global healthcare paradigm. *Frontiers in Artificial Intelligence*, 6:1227091. <https://doi:10.3389/frai.2023.1227091> [Accessed 20 August 2024]
- Kruszyńska-Fischbach, A., Sysko-Romańczuk, S., Rafalik, M., Walczak, R & Kludacz-Alessandri, M. 2021. Organizational E-Readiness for the Digital Transformation of Primary Healthcare Providers during the COVID-19 Pandemic in Poland. *Journal of Clinical Medicine*, 11(1):133. <https://doi:10.3390/jcm11010133> [Accessed 22 June 2024]
- Kulkov, I., Kulkova, J., Rohrbeck, R., Menvielle, L., Kaartemo, V. & Makkonen, H. 2024. Artificial intelligence - driven sustainable development: Examining organizational, technical, and processing approaches to achieving global goals. *Sustainable Development*, 32(3):1589-2868. <https://doi.org/10.1002/sd.2773> [Accessed 10 July 2024]
- Kulkov, I., Ivanova-Gongne, M., Bertello, A., Makkonen, H., Kulkova, J., Rohrbeck, R. & Ferraris, A. 2023. Technology entrepreneurship in healthcare: Challenges and opportunities for value creation. *Journal of Innovation & Knowledge*, 8(2). <https://doi.org/10.1016/j.jik.2023.100365> [Accessed 11 October 2023]
- Kunkel, D.E., Tietze, M.F., Wilson, M., Fant, C.T., Rivard, M-J., Belchez, C.A., Forman, T.M. & Husson, N.M. 2024. Creating Case Studies for Digital Health and Technology Competency in Nursing. *Nurse Educator*, 49(1):31-35. <https://doi:10.1097/NNE.0000000000001458> [Accessed 10 July 2024]
- Kusmaryono, I., Wijayanti, D. & Maharani, H.R. 2022. Number of response options, reliability, validity, and potential bias in the use of the Likert scale education and social science research: A literature review. *International Journal of Educational Methodology*, 8(4):625-637. <https://doi.org/10.12973/ijem.8.4> [Accessed 10 June 2024]

Kusumoto, F., Ross, J., Wright, D., Chazal, R.A. & Anderson, R.E. 2024. Analysis of Closed Claims Among All Medical Specialties: Importance of Communication and Other Non-Clinical Contributing Factors. *Risk Management and Healthcare Policy*, 17:411–422.
<https://doi.org/10.2147/RMHP.S403710> [Accessed 18 July 2024]

Kupe, T. 2019. *Universities are key to 4IR employment* [Online]. Available:
<https://www.thepeoplespace.com/ideas/articles/we-need-revolution-education-and-skills-if-humans-are-thrive-future-economy-says> [Accessed 10 July 2021]

Kwame, A., Petrucka, P.M. 2021. A literature-based study of patient-centered care and communication in nurse-patient interactions: barriers, facilitators, and the way forward. *BMC Nursing*, 20:158. <https://doi.org/10.1186/s12912-021-00684-2> [Accessed 31 May 2023]

Laakkonen, N., Jarva, E., Hammarén, M., Kanste, O., Kääriäinen, M., Oikarinen, A. & Mikkonen, K. 2024. Digital Competence among Healthcare Leaders: A Mixed-Methods Systematic Review, *Journal of Nursing Management*, 2024(8435248):34 pages.
<https://doi.org/10.1155/2024/8435248> [Accessed 24 July 2024]

Labrague, L.J., Aguilar-Rosales, R., Yboa, B.C., Sabio, J.B. & de los Santos, J.A. 2023. Student nurses' attitudes, perceived utilization, and intention to adopt artificial intelligence (AI) technology in nursing practice: A cross-sectional study. *Nurse Education in Practice*, 73:103815.
<https://doi.org/10.1016/j.nepr.2023.103815> [Accessed 29 May 2024]

Iacob, E.R., Iacob, R., Ghenciu, L.A., Popoiu, T-A., Stoicescu, E.R. & Popoiu, C.M. 2024. Small Scale, High Precision: Robotic Surgery in Neonatal and Pediatric Patients—A Narrative Review. *Children*, 11(3):270. <https://doi.org/10.3390/children11030270> [Accessed 20 August 2024]

Lafferty, M., Harrod, M., Krein, S. & Manojlovich, M. 2021. It's like sending a message in a bottle: A qualitative study of the consequences of one-way communication technologies in hospitals. *Journal of the American Medical Informatics Association*, 28(12):2601-2607.
<https://doi:10.1093/jamia/ocab191> [Accessed 13 June 2024]

Lama, S. 2024. A Critique of Positivism: Human Nature and Anarchy. *Unity Journal*, 5(1):77–90.
<https://doi.org/10.3126/unityj.v5i1.63161> [Accessed 18 July 2024]

Larbi, D., Denecke, K. & Gabarron, E. 2022. Usability Testing of a Social Media Chatbot for Increasing Physical Activity Behavior. *Journal of Personalised Medicine*, 12(5):828.
<https://doi:10.3390/jpm12050828>. [Accessed 13 June 2024]

Largent, E.A., Joffe, S., Dickert, N.W. & Morain, S.R. 2024. The ethical value of consulting community members in non-emergency trials conducted with waivers of informed consent for research. *Clinical Trials*, 0(0). <https://doi:10.1177/17407745241259360> [Accessed 15 July 2024]

Lau, S.T., Siah, C.J.R., Loh, W.L., Rusli, K.D.B., Schmidt, L.T., Lim, F.P. & Liaw, S.Y. 2023. Enhancing professional competency in clinical procedures using head-mounted display virtual reality - a mixed method study. *Medical Education Online*, 28(1):2232134.
<https://doi:10.1080/10872981.2023.2232134>. [Accessed 17 September 2023]

Lauer, K. & Camien, B. 2024. Evaluating Generation Z Students' Clinical Judgment Using Student-Produced Video Presentations. *Journal of Nursing Education*, 63(3):200-200.
<https://doi:10.3928/01484834-20240108-11> [Accessed 24 July 2024]

- Laukka, E., Hammarén, M., Pölkki, T. & Kanste, O. 2023. Hospital nurse leaders' experiences with digital technologies: A qualitative descriptive study. *Journal of Advanced Nursing*, 79(1):297-308. <https://doi:10.1111/jan> [Accessed 5 September 2023]
- Laurisz, N., Ćwiklicki, M., Żabiński, M., Canestrino, R. & Magliocca, P. 2023. The Stakeholders' Involvement in Healthcare 4.0 Services Provision: The Perspective of Co-Creation. *International Journal of Environmental Research and Public Health*, 20(3):2416. <https://doi:10.3390/ijerph20032416> [Accessed 5 September 2023]
- Lê, J.K. & Schmid, T. 2022. The Practice of Innovating Research Methods. *Organizational Research Methods*, 25(2):308-336. <https://doi.org/10.1177/1094428120935498> [Accessed 18 July 2024]
- Lee, T. 2024. An Eigenvalue Problem for Prescribed Curvature Equations. *International Mathematics Research Notices*, Volume 2024(10):8296–8312. <https://doi.org/10.1093/imrn/rnad220> [Accessed 20 July 2024]
- Lee, E. & Baek, G. 2024. Development and Effects of Adult Nursing Education Programs Using Virtual Reality Simulations. *Healthcare*, 12(13):1313. <https://doi.org/10.3390/healthcare12131313> [Accessed 24 July 2024]
- Lee, C-H. & Yuan, C-W. 2024. The Hidden Toll of Instant Messaging Use in Remote Work: Interaction Dynamics Between Subordinates and Supervisors. *CHI '24: Proceedings of the CHI Conference on Human Factors in Computing Systems*, 1022:1-15. <https://doi.org/10.1145/3613904.3642913> [Accessed 18 July 2024]
- Lee, N., Ahn, J. & Lim, W. 2023. Concurrent and Angle-Trajectory Validity and Intra-Trial Reliability of a Novel Multi-View Image-Based Motion Analysis System. *Journal of Human Kinetics*, 86:31-40. <https://doi:10.5114/jhk/159587> [Accessed 22 September 2023]
- Lee, M., Bin Mahmood, A.B.S., Lee, E.S., Smith, H.E. & Tudor Car, L. 2023. Smartphone and Mobile App Use Among Physicians in Clinical Practice: Scoping Review. *JMIR mHealth uHealth*, 11: e44765. <https://doi:10.2196/44765> [Accessed 17 September 2023]
- Lee, J.L., Rawl, S.M., Dickinson, S., Teal, E., Baker, L.B., Lyu, C., Tarver, W.L. & Haggstrom, D.A. 2020. Communication About Health Information Technology Use Between Patients and Providers. *Journal of General Internal Medicine*, 35(9):2614-2620. <https://doi:10.1007/s11606-020-05903-1> [Accessed 22 June 2024]
- Lekalakala-Mokgele, E., Lowane, M.P. & Mogale, N.M. 2023. Knowledge, Perceptions and Attitudes of eHealth and Health Technology among Nursing Students from Gauteng Province, South Africa. *Healthcare*, 11(12):1672. <https://doi:10.3390/healthcare11121672> [Accessed 14 September 2023]
- le Roux, L., Bimerew, M. & Chipps, J. 2024. Preparation of nursing students in nursing informatics competencies for the South African healthcare practice environment. *BMC Nursing*, 23(1):923. <https://doi:10.1186/s12912-024-02614-4> [Accessed 24 September 2024]
- Leon, R.J., Lapkin, S., Fields, L. & Moroney, T. 2022. Developing a self-administered questionnaire: methods and considerations. *Nurse Researcher*, 30(3):36–45. <https://doi.org/10.7748/nr.2022.e1848> [Accessed 9 March 2023]

Leslie, K., Bourgeault, I.L., Carlton, A-L., Balasubramanian, M., Mirshahi, R., Short, S.D., Carè, J., Cometto, G. & Lin, V. 2023. Design, delivery and effectiveness of health practitioner regulation systems: an integrative review. *Human Resources for Health*, 21(72). <https://doi.org/10.1186/s12960-023-00848-y> [Accessed 29 May 2024]

Li, Y., Wang, M., Wang, L., Cao, Y., Liu, Y., Zhao, Y., Yuan, R., Yang, M., Lu, S., Sun, Z., Zhou, F., Qian, Z. & Kang, H. 2024. Advances in the Application of AI Robots in Critical Care: Scoping Review. *Journal of Medical Internet Research*, 26: e54095. <https://doi:10.2196/54095> [Accessed 14 August 2024]

Li, J., Dada, A., Kleesiek, J. & Egger, J. 2023. ChatGPT in Healthcare: A Taxonomy and Systematic Review. *medRxiv*. <https://doi.org/10.1101/2023.03.30.23287899> [Accessed 7 October 2023]

Li, L. 2022. Reskilling and Upskilling the Future-ready Workforce for Industry 4.0 and beyond. *Information Systems Frontiers*, 13:1-16. <https://doi.org/10.1007/s10796-022-10308-y> [Accessed 3 September 2023]

Li, J. & Carayon, P. 2021. Health Care 4.0: A Vision for Smart and Connected Health Care. *IIEE Transaction on Healthcare Systems Engineering*, 11(3):171-180. <https://doi:10.1080/24725579.2021.1884627> [Accessed 22 September 2024]

Liang, J.T., Yang, C. & Myers, B.A. 2024. A Large-Scale Survey on the Usability of AI Programming Assistants: Successes and Challenges. ICSE '24: Proceedings of the 46th IEEE/ACM International Conference on Software Engineering, 52:1-13. <https://doi.org/10.1145/3597503.3608128> [Accessed 18 July 2024]

Lijun, Y. 2024. The Impact of the Cultural Revolution and the Transformation of Social Movements. In: Contest for Citizenship and Collective Violence During China's Cultural Revolution. IPP Studies in the Frontiers of China's Public Policy. Palgrave Macmillan, Singapore. https://doi.org/10.1007/978-981-97-0906-9_11 [Accessed 15 July 2024]

Lim, W.M. 2024. What Is Quantitative Research? An Overview and Guidelines. *Australasian Marketing Journal*, 0(0). <https://doi.org/10.1177/14413582241264622> [Accessed 13 March 2025]

Lindroth, H., Nalaie, K., Raghu, R., Ayala, I.N., Busch, C., Bhattacharyya, A., Moreno Franco, P., Diedrich, D.A., Pickering, B.W. & Herasevich, V. 2024. Applied Artificial Intelligence in Healthcare: A Review of Computer Vision Technology Application in Hospital Settings. *Journal of Imaging*, 10(4):81. <https://doi.org/10.3390/jimaging10040081> [Accessed 20 August 2024]

Lissitsa, S. 2024. "Generations X, Y, Z: the effects of personal and positional inequalities on critical thinking digital skills", *Online Information Review*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/OIR-09-2023-0453> [Accessed 20 July 2024]

Liu, Z., Wang, D. & Pan, Y. 2024. Superpopulation model inference for non-probability samples under informative sampling with high-dimensional data. *Communications in Statistics - Theory and Methods*, 1–21. <https://doi.org/10.1080/03610926.2024.2335543> [Accessed 18 July 2024]

Livesay, K., Petersen, S., Walter, R., Zhao, L., Butler-Henderson, K. & Abdolkhani, R. 2023. Sociotechnical Challenges of Digital Health in Nursing Practice During the COVID-19 Pandemic: National Study. *Journal of Medical Internet Research in Nursing*, 16(6): e46819. <https://doi:10.2196/46819>. [Accessed 23 October 2023]

Llop-Gironés, A., Vračar, A., Llop-Gironés, G., Benach, J., Angeli-Silva, L., Jaimez, L., Thapa, P., Bhatta, R., Mahindrakar, S., Bontempo Scavo, S., Nar Devi, S., Barria, S., Marcos Alonso, S. & Julià, M. 2021. Employment and working conditions of nurses: where and how health inequalities have increased during the COVID-19 pandemic? *Human Resources for Health*, 19(112). <https://doi.org/10.1186/s12960-021-00651-7> [Accessed 24 September 2024]

Lo, C.K. 2023. What Is the Impact of ChatGPT on Education? A Rapid Review of Literature. *Education Sciences*, 13(4):410. <https://doi.org/10.3390/educsci13040410> [Accessed 17 September 2023]

LoBiondo-Wood, G. & Haber, J. 2018. Nursing Research: Methods and Critical Appraisal for Evidence-Based Practice. 9th edition. St. Louis, Missouri: Elsevier

Loos, E. & Ivan, L. 2024. Not only people are getting old, new media are too: Technology generations and the changes in new media use. *New Media & Society*, 26(6):3588-3613. <https://doi.org/10.1177/14614448221101783> [Accessed 20 July 2024]

Loriot, A., Larceneux, F., Guillard, V. & Bertocchio, J.P. 2024. Patients' Representations of Perceived Distance and Proximity to Telehealth in France: Qualitative Study. *Journal of Medical Internet Research*, 26: e45702. <https://doi:10.2196/45702> [Accessed 24 July 2024]

Lottonen, T., Kaihlanen, A-M., Nadav, J., Hilama, P. & Heponiemi, T. 2024. Nurses' and physicians' perceptions of the impact of e-Health and information systems on the roles of health care professionals: A qualitative descriptive study. *Health Informatics Journal*, 30(1). <https://doi:10.1177/14604582241234261> [Accessed 10 July 2024]

Loureiro, F., Sousa, L. & Antunes, V. 2021. Use of Digital Educational Technologies among Nursing Students and Teachers: An Exploratory Study. *Journal of Personalized Medicine*, 11(10):1010. <https://doi:10.3390/jpm11101010>. [Accessed 14 September 2023]

Lövestam, G., Bremer-Hoffmann, S., Jonkers, K. & van Nes, P. 2024. Fostering scientific integrity and research ethics in a science-for-policy research organisation. *Research Ethics*, 0(0). <https://doi.org/10.1177/17470161241243001> [Accessed 20 July 2024]

Lübke, C. 2021. How self-perceived job insecurity affects health: Evidence from an age-differentiated mediation analysis. *Economic and Industrial Democracy*, 42(4):1105-1122. <https://doi.org/10.1177/0143831X19846333> [Accessed 21 November 2023]

Luft, J.A., Jeong, S., Idsardi, R. & Gardner, G. 2022. Literature Reviews, Theoretical Frameworks, and Conceptual Frameworks: An Introduction for New Biology Education Researchers. *CBE Life Sciences Education*, 21(3):rm33. <https://doi:10.1187/cbe.21-05-0134> [Accessed 15 September 2023]

Lukose, J., Kantore, A. & Fosu, A. 2021. Students' Readiness for Using E-learning in South African Rural Universities: A Case of Walter Sisulu University. *Global Conference on Business and Social Sciences Proceeding*, 12:100-100. [https://10.35609/gcbssproceeding.2021.12\(100\)](https://10.35609/gcbssproceeding.2021.12(100)) [Accessed 14 September 2023]

Lunardi, N., Abou-Zamzam, A., Florecki, K.L., Chidambaram, S., Shih, I-F., Kent, A.J., Joseph, B., Byrne, J.P. & Sakran, J.V. 2024. Robotic Technology in Emergency General Surgery Cases in the Era of Minimally Invasive Surgery. *JAMA Surgery*, 159(5):493-499. <https://doi:10.1001/jamasurg.2024.0016> [Accessed 24 July 2024].

Lund, B. 2021. The Fourth Industrial Revolution: Does It Pose an Existential Threat to Libraries? *Information Technology and Libraries*, 40(1). <https://doi.org/10.6017/ital.v40i1.13193> [Accessed 10 March 2023]

Luschi, A. 2024. Exploring radio frequency identification (RFID) in healthcare: Promises fulfilled or forsaken? *Technology and Health Care*, 32(4):2847-2849. <https://doi.org/10.3233/THC-231784> [Accessed 20 July 2024]

Luttrell, R.M., Harpin, H., Reville, E.G., Yu, Y. & Sweeney, A. 2024. "The Study of Baby Boomers and Generation Z's Attitudes Towards Generational Mental Health Dynamics". *Real Chemistry Emerging Insights Lab*, 4. https://surface.syr.edu/nhlabs_rc/4 [Accessed 20 July 2024]

Lynn, P., Bianchi, A. & Gaia, A. 2024. The Impact of day of Mailing on Web Survey Response Rate and Response Speed. *Social Science Computer Review*, 42(1):352-368. <https://doi.org/10.1177/08944393231173887> [Accessed 18 July 2024]

Maassen, S.M., van Oostveen, C., Vermeulen, H. & Weggelaar, A.M. 2021. Defining a positive work environment for hospital healthcare professionals: A Delphi study. *PLoS One*, 16(2): e0247530. <https://doi.org/10.1371/journal.pone.0247530> [Accessed 13 June 2024]

Mabona, J.F., van Rooyen, D. & Ten Ham-Baloyi, W. 2022. Best practice recommendations for healthy work environments for nurses: An integrative literature review. *Health SA*, 27:1788. <https://doi.org/10.4102/hsag.v27i0.1788> [Accessed 24 September 2024]

Mabungela, M. 2023. Artificial intelligence (AI) and automation in the world of work: A threat to employees? *Research in Social Sciences and Technology*, 8(4):135-146. <https://doi.org/10.46303/ressat.2023.37> [Accessed 13 June 2024]

Macdonald, G.M., McNeilly, P. & Kelly, B. 2020. Ethical considerations when conducting research with children and young people with disabilities in health and social care. *Nursing Research*. <https://doi.org/10.7748/nr.2020.e1645> [Accessed 12 October 2021]

Machon, M., Cundy, D. & Case, H. 2019. Innovation in Nursing Leadership: A Skill That Can Be Learned. *Nursing Administration Quarterly*, 43(3):267–273. <https://doi.org/10.1097/NAQ.0000000000000361> [Accessed 10 March 2023]

Mackey, A. & Gass, S. 2021. Research Variables, Validity, and Reliability. <https://doi.org/10.4324/9781003188414-13> [Accessed 12 October 2021]

MacNevin, W., Poon, E. & Skinner, T. 2021. Technology readiness of medical students and the association of technology readiness with specialty interest. *Canadian Medical Education Journal*, 12. <https://doi.org/10.36834/cmej.70624> [Accessed 2 July 2021]

Madanian, S., Nakarada-Kordic, I., Reay, S & Chetty, T. 2023. Patients' perspectives on digital health tools. *PEC Innovation*, 2:100171. <https://doi.org/10.1016/j.pecinn.2023.100171> [Accessed 29 May 2024]

Madlala, S.T. & Mvandaba, A.N. 2023. Experiences of nurse educators regarding the use of the clinical skills laboratory at the School of Nursing in the Free State province. *Health SA*, 28:2077. <https://doi.org/10.4102/hsag.v28i0.2077> [Accessed 15 September 2023]

Madziwa, P. K. & Masuku, M. 2024. Patient held medical records in public hospitals in Bulawayo. *Information Development*, 0(0). <https://doi.org/10.1177/02666669241262310> [Accessed 15 July 2024]

- Mafunda, B. & Swart, A. 2020. Determining African students' e-learning readiness to improve their e-learning experience. *Global Journal of Engineering Education*, 22(3): 216-221. <http://hdl.handle.net/11462/2488> [Accessed 5 September 2023]
- Mahat, D., Shrestha, S. & Neupane, D. 2024. Quantitative Research Design and Sample Trends: A Systematic Examination of Emerging Paradigms and Best Practices. *Cognizance Journal of Multidisciplinary Studies*, 4:20-27. <https://10.47760/cognizance.2024.v04i02.002> [Accessed 18 July 2024]
- Mahdinia, N., Pourabrahim, T., Sedaghat, M. & Ahmadi Tahor Soltani, M. 2024. Designing a model of factors affecting career decision, career path and attitude towards marriage among students. *Journal of Adolescent and Youth Psychological Studies (JAYPS)*, 5(1):98-110. <https://doi.org/10.61838/kman.jayps.5.1.12> [Accessed 20 July 2024]
- Mahmood, A., Kim, H., Chang, C.F., Kedia, S., Arshad, H. & Dillon, P.J. 2024. MHealth Apps Use and Their Associations with Healthcare Decision-Making and Health Communication Among Informal Caregivers: Evidence from the National Cancer Institute's Health Information National Trends Survey. *American Journal of Health Promotion*, 38(1):40-52. <https://doi:10.1177/08901171231202861> [Accessed 24 September 2024]
- Mahmoudi, H. & Moradi, M. 2024. The Progress and Future of Artificial Intelligence in Nursing Care: A Review. *Open Public Health Journal*, 17: e18749445304699. <http://dx.doi.org/10.2174/0118749445304699240416074458> [Accessed 22 June 2024]
- Mahsoon, A., Alnakli, M., Azab, S., Abed, M., Aabduqader, A., Sharif, L. & Sharif, K. 2024. Nursing Students' Attitudes toward Working in Mental Health Facilities in Saudi Arabia: A Cross-Sectional Study. *Healthcare*, 12(12):1168. <https://doi.org/10.3390/healthcare12121168> [Accessed 13 June 2024]
- Majid, U. 2018. Research Fundamentals: Study Design, Population, and Sample Size. *Undergraduate Research in Natural and Clinical Science and Technology (URNCSST) Journal*, 2. <https://doi.org/10.26685/urncst.16> [Accessed 16 October 2021]
- Majumder, M.A.A., Haque, M. & Razzaque, M.S. 2023. Editorial: Trends and challenges of medical education in the changing academic and public health environment of the 21st century. *Frontiers in Communication*, 8:1153764. <https://doi:10.3389/fcomm.2023.1153764> [Accessed 15 September 2023]
- Makapela, L. & Mtshelwane, N.D.P. 2021. Exploring the use and influence of human resource policies within South African municipalities. *SA Journal of Human Resource Management/SA Tydskrif vir Menslikehulpbronbestuur*, 19(0): a1534. <https://doi.org/10.4102/sajhrm.v19i0.1534> [Accessed 10 July 2024]
- Makie, G.C. 2024. Dissemination of the Vision, Mission, Goals, and Objectives of Urdaneta City University: Ethical Implications to Integrity, Teamwork, Competence and Transcendence. *International Journal of Empirical Research Methods*, 2(1):53-71. <https://doi:10.59762/ijerm205275792120240305165808> [Accessed 18 July 2024]
- Malak, M. & Al-Shakanbeh, M. 2023. Factors correlate acceptance of applying electronic health solution records among emergency nurses. *Journal of Human Behavior in the Social*

Environment, 34(1):119–129. <https://doi.org/10.1080/10911359.2023.2177228> [Accessed 14 August 2024]

Maleki Varnosfaderani, S. & Forouzanfar, M. 2024. The Role of AI in Hospitals and Clinics: Transforming Healthcare in the 21st Century. *Bioengineering*, 11(4):337. <https://doi.org/10.3390/bioengineering11040337> [Accessed 24 July 2024]

Malmqvist, J., Hellberg, K., Möllås, G., Rose, R. & Shevlin, M. (2019). Conducting the Pilot Study: A Neglected Part of the Research Process? Methodological Findings Supporting the Importance of Piloting in Qualitative Research Studies. *International Journal of Qualitative Methods*, 18. <https://doi.org/10.1177/1609406919878341> [Accessed 15 February 2023]

Manamela, L.E., Sumbane, G.O., Mutshatshi, T.E., Ngoatle, C. & Rasweswe, M.M.M. 2024. Multimodal teaching and learning challenges: Perspectives of undergraduate learner nurses at a higher education institution in South Africa. *African Journal of Health Professions Education*, 16(3):2-6. <https://dx.doi.org/10.7196/ajhpe.2024.v16i3.1299> [Accessed 24 September 2024]

Mansoor, A. & Mahabadi, N. 2023. Volume of Distribution. [Updated 2023 Jul 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK545280/>

Mansour, S. & Nogues, S. 2022. Advantages of and Barriers to Crafting New Technology in Healthcare Organizations: A Qualitative Study in the COVID-19 Context. *International Journal of Environmental Research and Public Health*, 19(16):9951. <https://doi.org/10.3390/ijerph19169951> [Accessed 22 June 2024]

Manti, S. & Licari, A. 2018. How to obtain informed consent for research. *Breathe (Sheff)*, 14(2):145-152. <https://doi.org/10.1183/20734735.001918> [Accessed 25 May 2023]

Mao, Y., Hu, B. & Kim, K.J. 2024. When AI doctors lie about diagnosis: The effects of varying degrees of prosocial lies in patient–AI interactions. *Technology in Society*, 76:102461. <https://doi.org/10.1016/j.techsoc.2024.102461> [Accessed 18 July 2024]

Marivate, V., Aghoghovwia, P., Ismail, Y., Mahomed-Asmail, F. & Steenhuisen, S.L. 2021. The Fourth Industrial Revolution– what does it mean to our future faculty? *South African Journal of Science*, 117(5/6): Art. #10702. <https://doi.org/10.17159/sajs.2021/10702> [Accessed 10 March 2023]

Margallo, D., Walker-Vischer, L. & Godin, M. 2024. How Implementing a Digital Competency Management System Reduced Nurse Training Cost and Improved NPD Practitioner Satisfaction in a Pediatric Hospital. *The Journal of Continuing Education in Nursing*, 55(5):239–245. <https://doi.org/10.3928/00220124-20240201-01> [Accessed 20 July 2024]

Maroju, R.G., Choudhari, S.G., Shaikh, M.K., Borkar, S.K. & Mendhe, H. 2023. Role of Telemedicine and Digital Technology in Public Health in India: A Narrative Review. *Cureus*, 15(3): e35986. <https://doi.org/10.7759/cureus.35986> [Accessed 13 September 2022]

Marougkas, A., Troussas, C., Krouska, A. & Sgouropoulou, C. 2023. Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade. *Electronics*, 12(13):2832. <https://doi.org/10.3390/electronics12132832> [Accessed 12 July 2024]

Martin, B., Kaminski-Ozturk, N., Smiley, R., Spector, N., Silvestre, J., Bowles, W. & Alexander, M. 2023. Assessing the Impact of the COVID-19 Pandemic on Nursing Education: A National Study

of Prelicensure RN Programs. *Journal of Nursing Regulation*, 14(1): S1-S67. [https://doi.org/10.1016/S2155-8256\(23\)00041-8](https://doi.org/10.1016/S2155-8256(23)00041-8) [Accessed 17 September 2023]

Martín-Lucas, J. & García del Dujo, Á. 2023. Knowledge-building in a n environment mediated by digital technology: A case study in higher education. *Education and Information Technologies*, 28:3267–3287. <https://doi.org/10.1007/s10639-022-11304-0> [Accessed 13 June 2024]

Martzoukou, K., Luders, E.S., Mair, J., Kostagiolas, P., Johnson, N., Work, F. & Fulton, C. 2024. A cross-sectional study of discipline-based self-perceived digital literacy competencies of nursing students. *Journal of Advanced Nursing*, 80(2):656-672. <https://doi.org/10.1111/jan.15801> [Accessed 15 July 2024]

Marwala T. 2023. The Fourth Industrial Revolution has arrived. Comments on Moll (*South African Journal of Science*, 119(1/2): Art. #12916) <https://doi.org/10.17159/sajs.2023/15429> [Accessed 3 September 2023]

Mashau, P. & Nyawo, J.C. 2021. The use of an online learning platform: a step towards e-learning. *South African Journal of Higher Education*, 35(2):123-143. <https://doi.org/10.20853/35-2-3985> [Accessed 22 September 2024]

Masoumian Hosseini, M., Masoumian Hosseini, S.T., Qayumi, K., Hosseinzadeh, S. & Saba Sajadi Tabar, S. 2023. Smartwatches in healthcare medicine: assistance and monitoring; a scoping review. *BMC Medical Informatics and Decision Making*, 23(248). <https://doi.org/10.1186/s12911-023-02350-w> [Accessed 12 July 2024]

Massaro, M. 2021. Digital transformation in the healthcare sector through blockchain technology. Insights from academic research and business developments. *Technovation*, 120:102386. <https://doi.org/10.1016/j.technovation.2021.102386> [Accessed 2 July 2022]

Masuwai, A., Zulkifli, H. & Hamzah, M.I. 2024. Evaluation of content validity and face validity of secondary school Islamic education teacher self-assessment instrument. *Cogent Education*, 11(1). <https://doi.org/10.1080/2331186X.2024.2308410> [Accessed 23 September 2024]

Matahela, V.E. & Makhanya, N.J. 2024. Towards a national policy on nursing education and training: an imperative framework for integrating nursing education within South Africa's post-school education system. *BMC Nursing*, 23:286. <https://doi.org/10.1186/s12912-024-01880-6> [Accessed 15 June 2024]

Matlhaba, K.L. 2023. Virtual Practical Examination for Student Nurse Educators in Health Sciences Education during the COVID-19 Pandemic: A Narrative Review. *Nursing Reports*, 13(1):214-229. <https://doi.org/10.3390/nursrep13010021> [Accessed 14 September 2023]

Matlhaba, K.L., Pienaar, A.J. & Sehularo, L.A. 2019. Community service nurses' experiences regarding their clinical competence. *Health SA*, 24:1284. <https://doi.org/10.4102/hsag.v24i0.1284> [Accessed 18 August 2021]

Matos, J.F., Freitas, A., Amado, C., Agonács, N. & Estrela, E. 2024. Research methodology courses in advanced studies in education: Trends from the Portuguese case. *International Journal of Instruction*, 17(4):405-420. <http://www.e-iji.net/> [Accessed 18 July 2024]

Matseke, M.G. 2023. Taking Stock of the Healthcare Workforce in the Public Health Sector of South Africa During Covid-19: Implications for Future Pandemics. *Africa Journal of Public Sector*

Development and Governance, 6(1). <https://doi.org/10.55390/ajpsdg.2023.6.1.5> [Accessed 21 June 2024]

Mayer, C-H. 2024. Leaders' views on leadership and skills development in the Fourth Industrial Revolution. *SA Journal of Industrial Psychology/SA Tydskrif vir Bedryfsielkunde*, 50(0): a2172. <https://doi.org/10.4102/sajip.v50i0.2172> [Accessed 14 July 2024]

Mbiza, M. & Sinha, S. 2023. The Fourth Industrial Revolution: Conceptual paradox or catalyst for achieving the Sustainable Development Goals? *South African Journal of Science*, 119(7/8): Art. #16090. <https://doi.org/10.17159/sajs.2023/16090> [Accessed 10 September 2023]

Mbunge, E., Batani, J., Gaobotse, G. & Muchemwa, B. 2022. Virtual healthcare services and digital health technologies deployed during coronavirus disease 2019 (COVID-19) pandemic in South Africa: a systematic review. *Global Health Journal*, 6(2):102-113. <https://doi.org/10.1016/j.glohj.2022.03.001> [Accessed 22 July 2024]

McCombes, S. 2022. Sampling Methods | Types, Techniques & Examples. Scribbr. <https://www.scribbr.com/methodology/sampling-methods/> [Accessed 15 February 2023]

McCombes, S. 2023a. What Is a Research Design | Types, Guide & Examples. Scribbr. <https://www.scribbr.com/methodology/research-design/> [Accessed 10 February 2023]

McCombes, S. 2023b. Writing Strong Research Questions | Criteria & Examples. Scribbr. <https://www.scribbr.com/research-process/research-questions/> [Accessed 4 September 2023]

McGarity, T., Monahan, L., Acker, K. & Pollock, W. 2023. Nursing Graduates' Preparedness for Practice: Substantiating the Call for Competency-Evaluated Nursing Education. *Behavioral Sciences (Basel)*, 13(7):553. <https://doi:10.3390/bs13070553> [Accessed 17 September 2023]

McGillem, C.D. 2023. "telegraph". *Encyclopedia Britannica*. <https://www.britannica.com/technology/telegraph>. [Accessed 19 September 2023]

McDonald, E.W., Boulton, J.L. & Davis, J.L. 2018. E-learning and nursing assessment skills and knowledge – An integrative review. *Nurse Education Today*, 66:166-174. <https://doi.org/10.1016/j.nedt.2018.03.011> [Accessed 13 July 2021]

McElroy, J.A., Day, T.M. & Becevic, M. 2020. The Influence of Telehealth for Better Health Across Communities. *Prevention of Chronic Diseases*, 17:200254. <https://doi.org/10.5888/pcd17.200254> [Accessed 16 August 2021]

Means, W.T. & Mowatt, R.A. 2023. Philosophy of science and leisure research: an exploratory analysis of research paradigms. *Leisure/Loisir*, 48(1):123–147. <https://doi.org/10.1080/14927713.2023.2187865> [Accessed 18 July 2024]

Megbowon, E.T. & David, O.O. 2023. Information and communication technology development and health gap nexus in Africa. *Frontiers in Public Health*, 11:1145564. <https://doi:10.3389/fpubh.2023.1145564> [Accessed 8 January 2024]

Mehrad, A. & Tahriri, M. 2019. Comparison Between Qualitative and Quantitative Research Approaches: Social Sciences. *International Journal for Research in Educational Studies*, 5(7):01–07. <https://doi.org/10.53555/es.v5i7.998> [Accessed 11 September 2022]

Mehrtak, M., SeyedAlinaghi, S., MohsseniPour, M., Noori, T., Karimi, A., Shamsabadi, A., Heydari, M., Barzegary, A., Mirzapour, P., Soleymanzadeh, M., Vahedi, F., Mehraeen, E. & Dadras, 2021. Security challenges and solutions using healthcare cloud computing. *Journal of*

Medicine and Life, 14(4):448-461. <https://doi.org/10.25122/jml-2021-0100> [Accessed 21 June 2024]

Melchiorre, M.G., Socci, M., Lamura, G. & Quattrini, S. 2024. The Social Sustainability of the Use of Information and Communication Technologies by Frail Older People Ageing in Place Alone in Italy: Barriers and Impact on Loneliness and Social Isolation. *Sustainability*, 16(15):6524. <https://doi.org/10.3390/su16156524> [Accessed 14 August 2024]

Mennella, C., Maniscalco, U., De Pietro, G. & Esposito, M. 2024. Ethical and regulatory challenges of AI technologies in healthcare: A narrative review. *Heliyon*, 10(4): e26297. <https://doi.org/10.1016/j.heliyon.2024.e26297> [Accessed 29 May 2024]

Menold, N. 2023. Verbalization of Rating Scales Taking Account of Their Polarity. *Field Methods*, 35(4):378-391. <https://doi.org/10.1177/1525822X231151314> [Accessed 20 July 2024]

Mensah, N.K., Adzakupah, G., Kissi, J., Taylor-Abdulai, H., Johnson, S.B., Agbeshie, P.A., Opoku, C., Abakah, J., Osei, E., Agyekum, A.Y. & Boadu, R.O. 2024. Health Professionals' Ethical, Security, and Patient Safety Concerns Using Digital Health Technologies: A Mixed Method Research Study. *Health Services Insights*, 17:11786329241303379. <https://doi.org/10.1177/11786329241303379> [Accessed 24 September 2024]

Menzies, J., Sabert, B., Hassan, R. & Mensah, P.K. 2024. Artificial intelligence for international business: Its use, challenges, and suggestions for future research and practice. *Thunderbird International Business Review*, 66:185–200. <https://doi.org/10.1002/tie.22370> [Accessed 20 July 2024]

Merriam-Webster. "Awareness." Merriam-Webster.com Dictionary, Merriam-Webster, <https://www.merriam-webster.com/dictionary/awareness> Accessed 24 July 2024]

Metcalfe, A., Stephenson, N., Cairncross, Z.F., Scime, N.V. & Fidler-Benaoudia, M. 2024. Exclusion of pregnant and lactating persons from breast cancer clinical trials: a review of active trials registered on ClinicalTrials.gov. *Acta Obstetrica et Gynecologica Scandinavica*, 103:707-715. <https://doi.org/10.1111/aogs.14599> [Accessed 18 July 2024]

Meum, T.T., Koch, T.B., Briseid, H.S., Vabo, G.L. & Rabben, J. 2021. Perceptions of digital technology in nursing education: A qualitative study, *Nurse Education in Practice*, 54:103136. <https://doi.org/10.1016/j.nepr.2021.103136> [Accessed 21 June 2024]

Meyer, E.T. & Schroeder, R. 2023. Knowledge machines: Digital transformations of the sciences and humanities. Mit Press. <https://doi.org/10.7551/mitpress/8816.001.0001> [Accessed 15 September 2023]

Mhlanga, D. 2022. Stakeholder Capitalism, the 4IR, and Sustainable Development: Issues to Be Resolved. *Sustainability*, 14(7):3902. <https://doi.org/10.3390/su14073902> [Accessed 5 September 2023]

Mhlanga, D. & Moloi, T. 2020. COVID-19 and the digital transformation of education: what are we learning on 4IR in South Africa? *Education Sciences*, 10:1–11. <https://doi.org/10.3390/educsci10070180> [Accessed 17 September 2023]

Miao, X., Han, Y., Wu, Z., Jin, X., Niu, M., Zhao, Q. & Lu, X. 2024. Reliability, Validity, Modification and Expansion of the Chinese Version of the Disease-Specific Anxiety Questionnaire for Chronic Obstructive Pulmonary Disease. *International Journal of Chronic*

Obstructive Pulmonary Disease, 19:1047–1060. <https://doi.org/10.2147/COPD.S455171> [Accessed 18 July 2024]

Miao, H. & Ahn, H. 2023. Impact of ChatGPT on Interdisciplinary Nursing Education and Research. *Asian Pacific Island Nursing Journal*, 7: e48136. <https://doi:10.2196/48136> [Accessed 17 September 2023]

Middleton, F. 2023. The 4 Types of Validity in Research: Definitions & Examples. Scribbr. <https://www.scribbr.com/methodology/types-of-validity/> [Accessed 9 March 2023]

Middleton, F. 2022. Reliability vs. Validity in Research: Difference, Types and Examples. Scribbr. <https://www.scribbr.com/methodology/reliability-vs-validity/> [Accessed 14 February 2023]

Milton, C.L. 2018. The ethics of scholarship with social media: *Nursing Science Quarterly*, 31(4):330-332. <https://doi:10.1177/0894318418792892>. [Accessed 11 September 2023]

Mishra, N., Sharma, H. & Garg, R. 2024. Generational Contrasts: A Comparative Analysis of Resilience, Interpersonal Communication, and Life Values in Gen X and Gen Z. *International Journal of All Research Education and Scientific Methods*, 12(3). <http://www.ijaresm.com/> [Accessed 24 September 2024]

Miteu, G.D. 2024. Ethics in scientific research: a lens into its importance, history, and future. *Annals of Medicine & Surgery*, 86(5):2395-2398. <https://doi:10.1097/MS9.0000000000001959> [Accessed 20 July 2024]

Mlambo, M., Silén, C. & McGrath, C. 2021. Lifelong learning and nurses' continuing professional development, a metasynthesis of literature. *BMC Nursing*, 20(1):62. <https://doi.org/10.1186/s12912-021-00579-2> [Accessed 5 September 2023]

Mncwango, B., Motala, S., Harvey, J. & Ngandu, S. 2024. Building a resilient skills ecosystem: situational analysis report on the forward path of education and training in light of the pandemic and 4IR/5IR shifts in the ETD sector: higher education subsector. Pretoria: *Human Sciences Research Council*. <http://hdl.handle.net/20.500.11910/23315> [Accessed 14 July 2024]

Mnkandla, M.M.A., Tshitangano, T.G. & Mudau, A.G. 2023. Healthcare-Seeking Behaviors of Homeless Substance Users During the COVID-19 Lockdowns in Gauteng, South Africa: A COREQ-Based Report. *Social Sciences*, 12(8):464. <https://doi.org/10.3390/socsci12080464> [Accessed 16 September 2024]

Möckli, N., Espinosa, J.A., Simon, M., Meyer-Masseti, C. & Zúñiga, F. 2023. Clarifying the muddy concept of home healthcare coordination: A comprehensive theoretical framework. *Heliyon*, 9(3): e14243. <https://doi:10.1016/j.heliyon.2023.e14243> [Accessed 17 September 2023]

Moerenhout, T., Devisch, I. & Cornelis, G.C. 2018. E-health beyond technology: analyzing the paradigm shift that lies beneath. *Medicine Health Care and Philosophy*, 21(1):31-41. <https://doi:10.1007/s11019-017-9780-3> [Accessed 15 October 2022]

Mofatteh, M. 2020. Risk factors associated with stress, anxiety, and depression among university undergraduate students. *AIMS Public Health*, 8(1):36-65. <https://doi:10.3934/publichealth.2021004> [Accessed 10 June 2024]

Moghimbeygi, M. & Golalizadeh, M. 2024. A New Class of Spherical Pearson-type Family of Distributions. *Journal of the Iranian Statistical Society*, 22(1):99-121. <https://doi:10.22034/jirss.2023.1996191.1004> [Accessed 20 July 2024]

- Mohajan, H. 2021. "The First Industrial Revolution: Creation of a New Global Human Era. *Journal of Social Sciences and Humanities*, 5(4):377-387. <https://mp.ra.ub.uni-muenchen.de/96644/> [Accessed 24 September 2024]
- Mohamed, R.A., Alhujaily, M., Ahmed, F.A., Nouh, W.G. & Almowafy, A.A. 2024. Exploring the potential impact of applying web-based training programs on nurses' knowledge, skills, and attitudes regarding evidence-based practice: A quasi-experimental study. *PLoS ONE*, 19(2): e0299864. <https://doi.org/10.1371/journal.pone.0299864> [Accessed 24 September 2024]
- Mohammadnejad, F., Freeman, S., Klassen-Ross, T., Hemingway, D. & Banner, D. 2023. Impacts of Technology Use on the Workload of Registered Nurses: A Scoping Review. *Journal of Rehabilitation and Assistive Technologies Engineering*, <https://doi:10.1177/20556683231180189> [Accessed 9 September 2023]
- Moll, I. 2023. Why there is no technological revolution, let alone a 'Fourth Industrial Revolution'. *South African Journal of Science*, 119(1-2):1-6. <https://dx.doi.org/10.17159/sajs.2023/12916> [Accessed 10 September 2023]
- Molla, A., Jannadi, R., Alayoubi, H., Altouri, H., Balkhair, M. & Hafez, D. 2024. Assessing the Relationship Between Vitiligo and Major Depressive Disorder Severity: Cross-Sectional Study. *JMIR Dermatology*, 7: e60686. <https://doi:10.2196/60686> [Accessed 18 July 2024]
- Monaghesh, E., Hajizadeh, A. 2020. The role of telehealth during COVID-19 outbreak: a systematic review based on current evidence. *BMC Public Health*, 20:1193. <https://doi.org/10.1186/s12889-020-09301-4> [Accessed 4 June 2023]
- Mondragon-Estrada, E. & Camacho-Zuniga, C. 2021. "Undergraduate's perspective on being an effective online student during lockdown due to COVID-19 pandemic: an educational data mining study. *Machine Learning-Driven Digital Technologies for Educational Innovation Workshop (Monterrey, Mexico, 1–5. https://doi:10.1109/IEEECONF53024.2021.9733773* [Accessed 14 September 2023]
- Montgomery, D.P. 2023. "This study is not without its limitations": Acknowledging limitations and recommending future research in applied linguistics research articles. *Journal of English for Academic Purposes*, 65:101291. <https://doi.org/10.1016/j.jeap.2023.101291> [Accessed 2 July 2024]
- Moore, J. 2023. AI in health care: the risks and benefits. <https://www.medicaleconomics.com/view/ai-in-health-care-the-risks-and-benefits> [Accessed 10 June 2024]
- Moore, A., Nguyen, A., Rivas, S., Bany-Mohammed, A., Majeika, J. & Martinez, L. 2021. A qualitative examination of the impacts of financial stress on college students' well-being: Insights from a large, private institution. *SAGE Open Medicine*, 22(9). <https://doi:10.1177/20503121211018122> [Accessed 15 November 2023]
- Moreau, D. & Wiebels, K. 2023. Ten simple rules for designing and conducting undergraduate replication projects. *PLoS Computational Biology*, 19(3): e1010957. <https://doi:10.1371/journal.pcbi.1010957> [Accessed 10 July 2024]
- Morrison, K.A. 2022. Reception, Translation, and British Liberalism's Continental Roots: Augustin Filon on John Morley's French Studies. *ANQ: A Quarterly Journal of Short Articles, Notes and*

Reviews, 37(2):244–250. <https://doi.org/10.1080/0895769X.2022.2104198> [Accessed 18 July 2024]

Morris, T.H. 2019. Self-directed learning: A fundamental competence in a rapidly changing world. *International Review of Education*, 65:633–653. <https://doi.org/10.1007/s11159-019-09793-2> [Accessed 16 July 2024]

Motsaanaka, M.N., Makhene, A. & Ndawo, G. 2024. Technology-based approaches to enhance clinical learning opportunities for student nurses in a nursing education institution in Gauteng, *International Journal of Africa Nursing Sciences*, 21:100790. <https://doi.org/10.1016/j.ijans.2024.100790> [Accessed 24 July 2024]

Motsi, L. 2024. 'Electronic health records model to improve the quality of patients' healthcare.' *Health SA Gesondheid*, 29(0): a2414. <https://doi.org/10.4102/hsag.v29i0.2414> [Accessed 12 September 2024]

Mouazzen, A-K., Blomberg, K. & Jaensson, M. 2024. Perceptions of interprofessional team collaboration among professionals working in the occupational health service in Sweden. *Journal of Occupational Health*, 66(1): uiad009. <https://doi.org/10.1093/joccuh/uiad009> [Accessed 24 September 2024]

Moudatsou, M., Stavropoulou, A., Philalithis, A. & Koukouli, S. 2020. The Role of Empathy in Health and Social Care Professionals. *Healthcare*, 8(1):26. <https://doi.org/10.3390/healthcare8010026> [Accessed 20 September 2024]

Moyo, I., Mavhandu-Mudzusi, A.H. & Haruzivishe, C. 2022. Frontline healthcare workers' experiences of providing care during the COVID-19 pandemic at a COVID-19 center in Bulawayo, Zimbabwe: A phenomenological study. *Curationis*, 45(1):1-11. <https://dx.doi.org/10.4102/curationis.v45i1.2292> [Accessed 22 June 2024]

Mozelius, P., Cleveland-Innes, M., Håkansson Lindqvist, M. & Jaldemark, J. 2024. Critical Aspects of a Higher Education Reform for Continuous Lifelong Learning Opportunities in a Digital Era, *The Electronic Journal of Knowledge Management*, 22(1):26-39. <https://doi.org/10.34190/ejkm.22.1.3258> [Accessed 14 July 2024]

Mrayyan, M.T., Algunaimeyn, A., Abunab, H.Y., Kutah, O.A., Alfayoumi, I. & Khait, A. 2023. Attributes, skills and actions of clinical leadership in nursing as reported by hospital nurses: a cross-sectional study. *BMJ Leader*, 25. <https://doi.org/10.1136/leader-2022-000672> [Accessed 5 September 2023]

Mukumba, P. & Shambira, N. 2022. Students' Technology Preference and Computer Technology Applications in the Teaching and Learning of Physics Modules at the University Undergraduate Level in South Africa during the COVID-19 Pandemic. *Education Sciences*, 12(11):771. <https://doi.org/10.3390/educsci12110771> [Accessed 14 September 2023]

Mulure, N., Hewadmal, H. & Khan, Z. 2024. Assessing Barriers to Primary Prevention of Cardiovascular Diseases in Low and Middle-Income Countries: A Systematic Review. *Cureus*, 16(7): e65516. <https://doi.org/10.7759/cureus.65516> [Accessed 20 August 2024]

Muradchanian, J., Hoekstra, R., Kiers, H., Fife, D. & van Ravenzwaaij, D. 2024. Comparing researchers' degree of dichotomous thinking using frequentist versus Bayesian null hypothesis

testing. *Scientific Reports*, 14:12120. <https://doi.org/10.1038/s41598-024-62043-w> [Accessed 20 July 2024]

Mwanza, J., Telukdarie, A. & Igusa, T. 2023. Impact of industry 4.0 on healthcare systems of low- and middle- income countries: a systematic review. *Health Technology*, 13:35–52. <https://doi.org/10.1007/s12553-022-00714-2> [Accessed 31 May 2023]

Naamneh, R. & Bodas, M. 2024. The effect of electronic medical records on medication errors, workload, and medical information availability among qualified nurses in Israel– a cross-sectional study. *BMC Nursing*, 23(270). <https://doi.org/10.1186/s12912-024-01936-7> [Accessed 22 September 2024]

Naeem, M., Ozuem, W., Howell, K. & Ranfagni, S. 2024b. Demystification and Actualisation of Data Saturation in Qualitative Research Through Thematic Analysis. *International Journal of Qualitative Methods*, 23. <https://doi.org/10.1177/16094069241229777> [Accessed 20 July 2024]

Naeem, M., Ozuem, W., Howell, K. & Ranfagni, S. 2023a. A Step-by-Step Process of Thematic Analysis to Develop a Conceptual Model in Qualitative Research. *International Journal of Qualitative Methods*, 22. <https://doi.org/10.1177/16094069231205789> [Accessed 18 July 2024]

Najafi, B. & Nasiri, A. 2023. Explaining Novice Nurses' Experience of Weak Professional Confidence: A Qualitative Study. *SAGE Open Nursing*, 9. <https://doi.org/10.1177/23779608231153457> [Accessed 17 September 2023]

Navab, E., Hoseini, A.T. & Darvish, A. 2024. Comparative study of master's degree curricula in nursing informatics at Tehran University of Medical Sciences and the University of Maryland. *Journal of Medical Education Development*, 17(53):91-100. <http://edujournal.zums.ac.ir/article-1-1685-en.html> [Accessed 18 July 2024]

Nayak, S.D.P. & Narayan, K.A. 2019. Strengths and Weaknesses of Online Surveys. *IOSR Journal of Humanities and Social Sciences (IOSR-JHSS)*, 24(5):31-38. <https://doi.org/10.9790/0837-2405053138> [Accessed 30 September 2023]

Ndou, A. 2024. The Difference in Parental Financial Socialisation Across Parental Education Level. *Research in Social Sciences and Technology*, 9(2):13-30. <https://doi.org/10.46303/ressat.2024.23> [Accessed 20 July 2024]

Negrin, K.A., Slaughter, S.E., Dahlke, S. & Olson, J. 2022. Successful Recruitment to Qualitative Research: A Critical Reflection. *International Journal of Qualitative Methods*, 21. <https://doi.org/10.1177/16094069221119576> [Accessed 4 September 2023]

Nel, C.P.G., van Zyl, G.J. & Labuschagne, M.J. 2021. Simulation in plastic surgery: Features and uses that lead to effective learning. *African Journal of Health Professions Education*, 13(1):29-35. <https://doi.org/10.7196/AJHPE.2021.v13i1.1181> [Accessed 15 July 2024]

Nes, A.A.G., Steindal, S.A., Larsen, M.H., Heer, H.C., Lærum-Onsager, E. & Gjevjon, E.R. 2021. Technological literacy in nursing education: A scoping review. *Journal of Professional Nursing*, 37(2):320-334. <https://doi.org/10.1016/j.profnurs.2021.01.008> [Accessed 10 July 2023]

Ng, J.Y., Chow, V., Santoro, L.J., Vieira Armond, A.C., Mirshahi, S.E., Cobey, K.D. & Moher, D. 20203. *MedRxiv*, 17:23295682. <https://doi.org/10.1101/2023.09.17.23295682> [Accessed 16 July 2024]

Ngusie, H.S., Kassie, S.Y., Chereka, Enyew, E.B. 2022. Healthcare providers' readiness for electronic health record adoption: a cross-sectional study during pre-implementation phase. *BMC Health Services Research*, 22(1):282. <https://doi.org/10.1186/s12913-022-07688-x> [Accessed 2 April 2023]

Nguyen, K.A., Resweber, C. & Karhadkar, S.S. 2023. Chapter 19 - Study population: Who and why them? Editor(s): Adam E.M. Eltorai, Jeffrey A. Bakal, Paige C. Newell, Adena J. Osband. In Handbook for Designing and Conducting Clinical and Translational Research. *Translational Surgery*, Academic Press, 121-125. <https://doi.org/10.1016/B978-0-323-90300-4.00024-0> [Accessed 18 July 2024]

Niang, M., Dupéré, S., Alami, H. & Gagnon, M. 2021. Why is repositioning public health innovation towards a social paradigm necessary? A reflection on the field of public health through the examples of Ebola and Covid-19. *Global Health*, 17:46. <https://doi.org/10.1186/s12992-021-00695-3> [Accessed 13 August 2021]

Nieuwboer, M.S., Perry, M., van der Sande, R., Maassen, I.T.H.M., Olde Rikkert, M.G.M. & van der Marck, M.A. 2018. Identification of influencing factors and strategies to improve communication between general practitioners and community nurses: a qualitative focus group study, *Family Practice*, 35(5):619–625. <https://doi.org/10.1093/fampra/cmy009> [Accessed 15 October 2023]

Nikolopoulou, K. 2022. What Is Non-Probability Sampling? Types & Examples. Scribbr. <https://www.scribbr.com/methodology/non-probability-sampling/> [Accessed 14 February 2023]

Nilsen, P., Seing, I., Ericsson, C., Birken, S.A. & Schildmeijer, K. 2020. Characteristics of successful changes in health care organizations: an interview study with physicians, registered nurses and assistant nurses. *BMC Health Services Research*, 20(147). <https://doi.org/10.1186/s12913-020-4999-8> [Accessed 24 September 2024]

Ning, X., Fan, Z., Burgun, E., Ren, Z. & Schleyer, T. 2021. Improving information retrieval from electronic health records using dynamic and multi-collaborative filtering. *PLoS ONE*, 16(8): e0255467. <https://doi.org/10.1371/journal.pone.0255467> [Accessed 24 May 2024]

Niraula, S.R. 2019. A review of research process, data collection and analysis. *Insights in Biology and Medicine*, 3:001-006. <https://doi.org/10.29328/journal.ibm.1001014> [Accessed 16 February 2023]

Noble, S.M., Mende, M., Grewal, D. & Parasuraman, A. 2022. The Fifth Industrial Revolution: How Harmonious Human–Machine Collaboration is Triggering a Retail and Service [R]evolution. *Journal of Retailing*, 98(2):199-208. <https://doi.org/10.1016/j.jretai.2022.04.003> [Accessed 10 September 2023]

Nojima, K., Nishino, T. & Martinez, M. 2023. Changes in Active Class Attitudes Towards Learning and in Discussion Skills of Nursing University Students Engaged in Simulation-Based Education, *Clinical Simulation in Nursing*, 79:1-5. <https://doi.org/10.1016/j.ecns.2022.12.002> [Accessed 14 September 2023]

Nordén, B. 2024. Advancing Sustainability through Higher Education: Student Teachers Integrate Inner Development Goals (IDG) and Future-Oriented Methodologies. *Challenges*, 15(2):28. <https://doi.org/10.3390/challe15020028> [Accessed 18 July 2024]

Noyes, J., Booth, A., Moore, G., Flemming, K., Tunçalp, Ö., Shakibazadeh, E. 2019. Synthesising quantitative and qualitative evidence to inform guidelines on complex interventions: clarifying the purposes, designs and outlining some methods. *BMJ Global Health*, 4(Suppl1): e000893. <https://doi:10.1136/bmjgh-2018-000893> [Accessed 26 May 2023]

Noviyanti, L.W., Ahsan, A & Sudartya, T.S. 2021. Exploring the relationship between nurses' communication satisfaction and patient safety culture. *Journal of Public Health Research*, 10(2):2225. <https://doi:10.4081/jphr.2021.2225> [Accessed 13 June 2024]

Nuuyoma, V., Lauliso, S.S. & Chihururu, L. 2023. 'Perspectives of nursing students on challenges of e-learning during early stages of the COVID-19 pandemic', *Curationis*, 46(1): a2358. <https://doi.org/10.4102/curationis.v46i1.2358> [Accessed 17 September 2023]

Nxumalo, C.T., Pillay, P. & Mchunu, G.G. 2024. The Durban University of Technology Faculty of Health Sciences Decentralized Clinical Training Project: Protocol for an Implementation Study in KwaZulu-Natal, South Africa. *JMIR Research Protocols*, 13: e52243. <https://doi:10.2196/52243> [Accessed 22 June 2024]

Nyelisani, M., Makhado, L. & Luhlima, T. 2023. A Professional Nurse's understanding of quality nursing care in Limpopo province, South Africa. *Curationis*, 46(1):1-7. <https://dx.doi.org/10.4102/curationis.v46i1.2322> [Accessed 24 June 2024]

Nyimbili, F. & Nyimbili, L. 2024. Types of Purposive Sampling Techniques with Their Examples and Application in Qualitative Research Studies. *British Journal of Multidisciplinary and Advanced Studies*, 5(1):90–99. <https://doi.org/10.37745/bjmas.2022.0419> [Accessed 18 July 2024]

Nygren, J.M., Lundgren, L., Bäckström, I. & Svedberg, P. 2023. Strengthening Digital Transformation and Innovation in the Health Care System: Protocol for the Design and Implementation of a Multidisciplinary National Health Innovation Research School. *JMIR Research Protocols*, 12: e46595. <https://doi:10.2196/46595> [Accessed 4 September 2023]

O'Connell, M., Barry, J., Hartigan, I., Cornally, N. & Saab, M.M. 2024. The impact of electronic and self-rostering systems on healthcare organisations and healthcare workers: A mixed-method systematic review. *Journal of Clinical Nursing*, 33:2374–2387. <https://doi.org/10.1111/jocn.17114> [Accessed 24 July 2024]

O'Connor, T., Gibson, J., Lewis, J., Strickland, K. & Paterson, C. 2023. Decision-making in nursing research and practice—Application of the Cognitive Continuum Theory: A meta-aggregative systematic review. *Journal of Clinical Nursing*, 32:7979–7995. <https://doi.org/10.1111/jocn.16893> [Accessed 10 July 2024]

O'Connor, S. & Andrews, T. 2018. Smartphones and mobile applications (apps) in clinical nursing education: a student perspective. *Nurse Education Today*, 69:172-178. <https://doi.org/10.1016/j.nedt.2018.07.013> [Accessed 2 July 2021]

Odede, I. 2021. 'An assessment of students' perception and self-efficacy towards mobile learning: A case of University of Zululand: *South African Journal of Information Management*, 23(1):1-8. <https://doi.org/10.4102/sajim.v23i1.1268> [Accessed 2 April 2023]

Oducado, R.M. & Sumagaysay, N. 2019. Newly graduates Nurses: Transition Difficulties, Support Needed and Satisfaction with the Work Environment. Available at SSRN: <https://doi.org/10.13140/RG.2.2.13683.89125> [Accessed 28 March 2023]

Ogbonna, N. 2024. An Overview of Research Study Designs in Quantitative Research Methodology: Research Article. *American Journal of Medical and Clinical Research & Reviews*, 3(5):1–6. <https://doi.org/10.58372/2835-6276.1169> [Accessed 18 July 2024]

O'Hara, C. & Reid, M. 2024. The Under 35 Nursing Workforce in 2022: Overworked, Under Supported, and Burned Out. *Journal of Nursing Regulation*, 15(1):45-55. [https://doi.org/10.1016/S2155-8256\(24\)00028-0](https://doi.org/10.1016/S2155-8256(24)00028-0) [Accessed 10 July 2024]

Ohneberg, C., Stöbich, N., Warmbein, A., Rathgeber, I., Mehler-Klamt, A.C., Fischer, U. & Eberl, I. 2023. Assistive robotic systems in nursing care: a scoping review. *BMC Nursing*. 22(72). <https://doi.org/10.1186/s12912-023-01230-y> [Accessed 31 May 2023]

Okolo, C.A., Babawarun, O., Arowoogun, J.O., Adeniyi, A.O. & Chidi, R. 2024. The role of mobile health applications in improving patient engagement and health outcomes: A critical review. *International Journal of Science and Research Archive*, 11:2566–2574. <https://doi.org/10.30574/ijrsra.2024.11.1.0334> [Accessed 20 August 2024]

Okolo, C.A., Ijeh, S., Arowoogun, J.O., Adeniyi, A.O. & Omotayo, O. 2024. REVIEWING THE IMPACT OF HEALTH INFORMATION TECHNOLOGY ON HEALTHCARE MANAGEMENT EFFICIENCY. *International Medical Science Research Journal*, 4(4):420-440. <https://doi:10.51594/imsrj.v4i4.1000> [Accessed 10 July 2024]

Okoye, K., Hussein, H., Arrona-Palacios, A., Nahún Quintero, N., Luis Omar Peña Ortega, L.M., Lopez Sanchez, A., Arias Ortiz, E., Escamilla, J. & Hosseini, S. 2023. Impact of digital technologies upon teaching and learning in higher education in Latin America: an outlook on the reach, barriers, and bottlenecks. *Education and Information Technology*, 28:2291–2360. <https://doi.org/10.1007/s10639-022-11214-1> [Accessed 21 August 2023]

Oliveira, A. 2024. Considerations on the Nature of Science and Technology. *Advances in Historical Studies*, 13:94-111. <https://doi:10.4236/ahs.2024.132005> [Accessed 18 July 2024]

Oliveira, L.G.F., Fracolli, L.A., Pina-Oliveira, A.A., Gryscek, AL de F.P.L., Vaz, D.R., da Silva, E.E.A., Pereira, T.Z., Campos, D.S., Geraldo, D.C. & Farias, L.G. 2024. The challenge of cultural changes for the reorganization of the health service. *CONTRIBUTIONS TO SOCIAL SCIENCES*, 17(2): e4287. <https://doi.org/10.55905/revconv.17n.2-024> [Accessed 24 September 2024]

Olmos-Vegaa, F.M., Stalmeijerb, R.E., Varpioc, L & Kahlked, R. 2023. A practical guide to reflexivity in qualitative research: AMEE Guide No. 149. *Medical Teacher*, 45(3):241–251. <https://doi.org/10.1080/0142159X.2022.2057287> [Accessed 13 June 2024]

Olorunfemi, O. & Akinyemi, T.A. 2024. Science and practice of nursing: The impact of technology. *Digital Medicine*, 10(3): e24-00003. <https://doi:10.1097/DM-2024-00003> [Accessed 24 September 2024]

Olsen, M.T., Klarskov, C.K., Dungu, A.M., Hansen, K.B., Pedersen-Bjergaard, U. & Kristensen, P.L. 2024. Statistical Packages and Algorithms for the Analysis of Continuous Glucose Monitoring Data: A Systematic Review. *Journal of Diabetes Science and Technology*, 0(0). <https://doi:10.1177/19322968231221803> [Accessed 20 July 2024]

Olsson, T., Sentilles, S. & Papatheocharous, E. 2022. A systematic literature review of empirical research on quality requirements. *Requirements Engineering*, 27:249–271. <https://doi.org/10.1007/s00766-022-00373-9> [Accessed 1 June 2023]

Ombaka, B. & Muturi, M. 2024. Importance of Ethics in Safeguarding and Ensuring High Quality Research. *Journal of African Interdisciplinary Studies*, 8(6):89–100.
<https://kenyasocialscienceforum.wordpress.com/wp-content/uploads/2024/06/pdf-ombaka-muturi-importance-of-ethics-in-safeguarding-and-ensuring-high-quality-research-1.pdf> [Accessed 14 July 2024]

Omda, E.L & Sergeant, S.R. 2022. Standard Deviation. [Updated 2022 Aug 22]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing from:
<https://www.ncbi.nlm.nih.gov/books/NBK574574/> [Accessed 16 February 2023]

Omodan, B.I. 2022. A Model for Selecting Theoretical Framework Epistemology of Research Paradigms: *African Journal of Inter/Multidisciplinary Studies*, 4(1):275-285.
<https://journals.co.za/doi/abs/10.51415/ajims.v4i1.1022> [Accessed 7 October 2023]

Oosthuizen, R.M. 2022. The Fourth Industrial Revolution - Smart Technology, Artificial Intelligence, Robotics and Algorithms: Industrial Psychologists in Future Workplaces. *Frontiers in Artificial Intelligence*, 5:913168. <https://www.frontiersin.org/articles/10.3389/frai.2022.913168> [Accessed 10 September 2023]

Oosthuizen, J.H., Ungerer, M. & Volschenk, J. 2023. A fourth industrial revolution integrated intelligence taxonomy for top management. *Journal of Contemporary Management*, 20(1):404-443. <https://dx.doi.org/10.35683/jcm1018.202> [Accessed 22 June 2024]

Ortega-Lapiedra, R., Barrado-Narvi3n, M.J. & Bernu3s-Oliv3n, J. 2023. Acquisition of Competencies of Nurses: Improving the Performance of the Healthcare System. *International Journal of Environmental Research and Public Health*, 20(5):4510.
<https://doi:10.3390/ijerph20054510> [Accessed 15 September 2023]

Osama, M., Ateya, A.A., Sayed, M.S., Hammad, M., Pławiak, P., Abd El-Latif, A.A. & Elsayed, R. A. 2023. Internet of Medical Things and Healthcare 4.0: Trends, Requirements, Challenges, and Research Directions. *Sensors*, 23(17):7435. <https://doi.org/10.3390/s23177435> [Accessed 24 July 2024]

Osei, E., Apiribu, F., Kissi, J., Asante, L.S., Ampon-Wireko, S. & Mashamba-Thompson, T.P. 2024. Healthcare workers' perspectives on the availability and use of mobile health technologies for disease diagnosis and treatment support in the Ashanti Region of Ghana. *PLoS ONE*, 19(4): e0294802. <https://doi.org/10.1371/journal.pone.0294802> [Accessed 20 August 2024]

Padovano, A. & Cardamone, M. 2024. Towards human-AI collaboration in the competency-based curriculum development process: The case of industrial engineering and management education. *Computers and Education: Artificial Intelligence*, 7:100256.
<https://doi.org/10.1016/j.caeai.2024.100256> [Accessed 22 September 2024]

Pailaha, A.D. 2023. The Impact and Issues of Artificial Intelligence in Nursing Science and Healthcare Settings. *SAGE Open Nursing*, 9:23779608231196847.
<https://doi:10.1177/23779608231196847> [Accessed 16 September 2024]

Pamplona, F. 2023. What are statistical parametric tests and where to apply them?
<https://mindthegraph.com/blog/statistics-parametric-tests/> [Accessed 22 September 2023]

Panayiotou, A., Gardner, A., Williams, S., Zucchi, E., Mascitti-Meuter, M., Goh, A.M., You, E., Chong, T.W., Logiudice, D., Lin, X., Haralambous, B. & Batchelor, F. 2019. Language

Translation Apps in Health Care Settings: Expert Opinion. *JMIR mHealth uHealth*, 7(4): e11316. <https://doi.org/10.2196/11316> [Accessed 30 May 2023]

Panda, A. & Mohapatra, S. 2024. "Research Design", *The Online Healthcare Community*, Emerald Publishing Limited. Leeds, 53-62. <https://doi.org/10.1108/978-1-83549-140-920241004> [Accessed 20 July 2024]

Panda, S., Dash, M., Mishra, R., Shettigar, S.A., Gurav, D.M., Kuppan, S. & Mohan, S. 2023. Voice from the frontline and learning for the future: A qualitative descriptive study on wider perspectives of frontline nurses in India during the COVID 19 global pandemic. *Clinical Epidemiology and Global Health*, 21. <https://doi.org/10.1016/j.cegh.2023.101298> [Accessed 18 September 2023]

Pappa, D., Evangelou, E., Koutelekos, I., Dousis, E., Toulia, G., Stavropoulou, A., Margari, N., Giga, A., Ferentinou, E., Chasaki, K., Bilali, A., Zartaloudi, A. & Dafogianni, C. 2024. Investigation of Nursing Errors in Greek Pediatric Hospitals. *Hospitals*, 1(1):75-86. <https://doi.org/10.3390/hospitals1010007> [Accessed 15 July 2024]

Park, S., Marquard, J., Austin, R.R., Pieczkiewicz, D., Jantraporn, R. & Delaney, C.W. 2024. A Systematic Review of Nurses' Perceptions of Electronic Health Record Usability Based on the Human Factor Goals of Satisfaction, Performance, and Safety. *CIN: Computers, Informatics, Nursing*, 42(3):168-175. <https://doi.org/10.1097/CIN.0000000000001084> [Accessed 10 July 2024]

Park, Y.S., Konge, L. & Artino, A.R. Jr. 2020. The Positivism Paradigm of Research. *Academic Medicine*, 95(5):690-694. <https://doi.org/10.1097/ACM.0000000000003093> [Accessed 14 September 2023]

Parra-Fica, J.H., López-Martín, M.D.M. & Díaz-Levicoy, D. 2024. Measures of central tendency in primary education textbooks in Chile. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(6): em2454. <https://doi.org/10.29333/ejmste/14592> [Accessed 10 June 2024]

Pascucci, F., Savelli, E. & Gistri, G. 2023. "How digital technologies reshape marketing: evidence from a qualitative investigation," *Italian Journal of Marketing*, Springer, (1):27-58. <https://doi.org/10.1007/s43039-023-00063-6> [Accessed 14 September 2023]

Paul, M., Maglaras, L., Ferrag, M.A. & Almomani, I. 2023. Digitization of healthcare sector: A study on privacy and security concerns. *ICT Express*, 9(4):571-588. <https://doi.org/10.1016/j.icte.2023.02.007> [Accessed 10 September 2023]

Paulus, F.W., Joas, J., Friedmann, A., Fuschlberger, T., Möhler, E. & Mall, V. 2024. Familial context influences media usage in 0- to 4-year-old children. *Frontiers in Public Health*, 11:1256287. <https://doi.org/10.3389/fpubh.2023.1256287> [Accessed 10 June 2024]

Pedregosa, S., Zabalegui, A., Fabrellas, N., Risco, E., Pereira, M., Dmoch-Gajzlerska, E., Şenuzun, F. & Martin, S. 2024. Nurses, midwives and students' reports of effective dedicated education units in five European countries: A qualitative study. *Nursing Open*, 11: e2210. <https://doi.org/10.1002/nop2.2210> [Accessed 15 July 2024]

Pelletier, A., Kaewkitipong, L. & Guitton, M.J. 2024. Using technology to study refugee, conflict-affected, and hard-to-reach populations: Methodological and ethical considerations. *Computers in Human Behavior*, 152:108053. <https://doi.org/10.1016/j.chb.2023.108053> [Accessed 20 July 2024]

- Penprase, B. 2018. The Fourth Industrial Revolution and Higher Education. In: Gleason, N. editor. *Higher Education in the Era of the Fourth Industrial Revolution*. 207-229. Palgrave Macmillan. Singapore. <https://doi.org/10.1007/978-981-13-0194-09> [Accessed 18 August 2021]
- Pepito, J.A. & Locsin, R. 2019. Can nurses remain relevant in a technologically advanced future? *International Journal of Nursing Sciences*, 6(1):106-110. <https://doi.org/10.1016/j.ijnss.2018.09.013> [Accessed 28 March 2023]
- Pereira da Veiga, C.R., Lima de Moraes, A.L., Gonçalves Marques, V., Martins da Silva, D. & Pereira da Veiga, C. 2024. Advancing nursing education in Brazil: A systematic literature review of curricular evolution and emerging challenges. *Nurse Education Today*, 139:106228. <https://doi.org/10.1016/j.nedt.2024.106228> [Accessed 15 July 2024]
- Pereira, R. & dos Santos, N. 2023. Neoindustrialisation—Reflections on a New Paradigmatic Approach for the Industry: A Scoping Review on Industry 5.0. *Logistics*, 7(3):43. <https://doi.org/10.3390/logistics7030043> [Accessed 14 July 2024]
- Perez, C. 2024. "VIA-IS-M And Latinx Cultural Strengths: A Study Validation & Confirmatory Factor Analysis" (2023). *Theses and Dissertations*. 5327. <https://commons.und.edu/theses/5327>
- Pérez-Juárez, M.Á., González-Ortega, D. & Aguiar-Pérez, J.M. 2023. Digital Distractions from the Point of View of Higher Education Students. *Sustainability*, 15(7):6044. <https://doi.org/10.3390/su15076044> [Accessed 21 June 2024]
- Perifanis, N.A. & Kitsios, F. 2023. Investigating the Influence of Artificial Intelligence on Business Value in the Digital Era of Strategy: A Literature Review. *Information*, 14(2):85. <https://doi.org/10.3390/info14020085> [Accessed 5 September 2023]
- Perkins, M. 2023. Academic Integrity considerations of AI Large Language Models in the post-pandemic era: ChatGPT and beyond. *Journal of University Teaching & Learning Practice*, 20(2). <https://doi.org/10.5376/1.20.02.07> [Accessed 17 September 2023]
- Petersson, L., Larsson, I., Nygren, J.M., Nilsen, P., Neher, M., Reed, J.E., Tyskbo, D. & Svedberg, P. 2022. Challenges to implementing artificial intelligence in healthcare: a qualitative interview study with healthcare leaders in Sweden. *BMC Health Services Research*, 22(850). <https://doi.org/10.1186/s12913-022-08215-8> [Accessed 21 June 2024]
- Pfeifer, L., Fries, S., Stirner, A., Nagel, L., Cohnen, C., Aschentrup, L., Schönbeck, M., Nauwerth, A., Raschper, P., Herzig, T. & Wrona, K.J. 2024. Positive Aspects and Potential Drawbacks of Implementing Digital Teaching/Learning Scenarios in Health Professions Using Nursing Education as an Example: A Research Report from Germany. *Nursing Reports*, 14(1):468-481. <https://doi.org/10.3390/nursrep14010036> [Accessed 15 July 2024]
- Philbeck, T.D. & Davis, N.R. 2018. The Fourth Industrial Revolution: Shaping a New Era. *Journal of International Affairs*, 72(1):17-21. <https://www.jstor.org/stable/10.2307/26588339> [Accessed 18 August 2021]
- Pilcher, N. & Cortazzi, M. 2023. 'Qualitative' and 'quantitative' methods and approaches across subject fields: implications for research values, assumptions, and practices. *Quality & Quantity*, 58:2357–2387. <https://doi.org/10.1007/s11135-023-01734-4> [Accessed 13 June 2024]
- Podsakoff, P.M., Podsakoff, N.P., Williams, L.J., Huang, C. & Yang, J. 2024. Common Method Bias: It's Bad, It's Complex, It's Widespread, and It's Not Easy to Fix. *Annual Review of*

Organizational Psychology and Organizational Behavior, 11:17-61

<https://doi.org/10.1146/annurev-orgpsych-110721-040030> [Accessed 18 July 2024]

Polit, D. F. & Beck, C. T. 2018. *Essentials of Nursing research: Appraising Evidence for Nursing Practice*. 9th edition. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.

<https://nursology.net/resources/books/essentials-of-nursing-research-appraising-evidence-for-nursing-practice/> [Accessed 14 February 2023]

Polit, D. F. & Beck, C. T. 2021. *Nursing research: generating and assessing evidence for nursing practice*. Eleventh edition. Philadelphia, Wolters Kluwer.

<https://cmc.marmot.org/Record/.b62526911> [Accessed 15 February 2021]

Popescu, C., El-Chaarani, H., El-Abiad, Z. & Gigauri, I. 2022. Implementation of Health Information Systems to Improve Patient Identification. *International Journal of Environmental Research and Public Health*, 19(22):15236. <https://doi:10.3390/ijerph192215236> [Accessed 12 November 2023]

Popov, V.V., Kudryavtseva, E.V., Kumar Katiyar, N., Shishkin, A., Stepanov, S.I. & Goel, S. 2022. Industry 4.0 and Digitalisation in Healthcare. *Materials (Basel)*, 15(6):2140.

<https://doi:10.3390/ma15062140> [Accessed 5 September 2023]

Poth, C.N., Wongvorachan, T., Bulut, O. & Otto, S.J.G. 2024. Adaptive Case Study-Mixed Methods Design Practices for Researchers Studying Complex Phenomena. *Journal of Mixed Methods Research*, 0(0). <https://doi.org/10.1177/15586898241250217> [Accessed 20 July 2024]

Pourtaheri, A., Sany, S.B.T., Aghaee, M.A., Ahangari, H. & Peyman, N. 2023. Prevalence and factors associated with child marriage, a systematic review. *BMC Womens Health*, 23(1):531.

<https://doi:10.1186/s12905-023-02634-3> [Accessed 15 November 2023]

Power, E.G.M. 2023. Considerations for Effective Communication of Medical Information. *Pharmaceutical Medicine*, 37(2):97-101. <https://doi:10.1007/s40290-023-00461-3> [Accessed 30 August 2023]

Prado-Gascó, V., Giménez-Espert, M.D.C & De Witte H. 2021. Job Insecurity in Nursing: A Bibliometric Analysis. *International Journal of Environmental Research and Public Health*, 18(2):663. <https://doi:10.3390/ijerph18020663> [Accessed 21 November 2023]

Prediger, S. 2024. Conjecturing is not all: Theorizing in design research by refining and connecting categorial, descriptive, and explanatory theory elements. *Educational Design Research*, 8(1):1-30. <https://dx.doi.org/10.15460/eder.8.1.2120> [Accessed 15 July 2024]

Pressley, C. & Garside, J. 2023. Safeguarding the retention of nurses: A systematic review on determinants of nurse's intentions to stay. *Nursing Open*, 10(5):2842-2858.

<https://doi:10.1002/nop2.1588> [Accessed 24 July 2024]

Profetto, L., Gherardelli, M. & Iadanza, E. 2022. Radio Frequency Identification (RFID) in health care: where are we? A scoping review. *Health Technology*, 12:879–891.

<https://doi.org/10.1007/s12553-022-00696-1> [Accessed 24 September 2024]

Prokofieva, M., Zarate, D., Parker, A., Palikara, O. & Stavropoulos, V. 2023. Exploratory structural equation modeling: a streamlined step by step approach using the R Project software. *BMC Psychiatry*, 23(1):546. <https://doi:10.1186/s12888-023-05028-9> [Accessed 4 September 2023]

Pulimamidi, R. 2024. To enhance customer (or patient) experience based on IoT analytical study through technology (IT) transformation for E-healthcare, Measurement: *Sensors*, 33:101087. <https://doi.org/10.1016/j.measen.2024.101087> [Accessed 10 July 2024]

Purna Singh, A., Vadakedath, S. & Kandi, V. 2023. Clinical Research: A Review of Study Designs, Hypotheses, Errors, Sampling Types, Ethics, and Informed Consent. *Cureus*, 15(1): e33374. <https://doi:10.7759/cureus.33374> [Accessed 16 September 2023]

Pyo, J., Lee, W., Choi, E.Y., Jang, S.G. & Ock, M. 2023. Qualitative Research in Healthcare: Necessity and Characteristics. *Journal of Preventative Medicine and Public Health*, 56(1):12-20. <https://doi:10.3961/jpmph.22.451> [Accessed 29 May 2023]

Raffinetti, E. 2023. A Rank Graduation Accuracy measure to mitigate Artificial Intelligence risks. *Quality & Quantity*, 57(2):131–150. <https://doi.org/10.1007/s11135-023-01613-y> [Accessed 22 September 2023]

Raghunathan, K., McKenna, L. & Peddle, M. 2023. Baseline evaluation of nursing students' informatics competency for digital health practice: A descriptive exploratory study. *DIGITAL HEALTH*, 9. <https://doi:10.1177/20552076231179051> [Accessed 16 August 2023]

Rahman, M. 2023. Sample Size Determination for Survey Research and Non-Probability Sampling Techniques: A Review and Set of Recommendations. *Journal of Entrepreneurship, Business and Economics*, 11(1):42-62. <http://orcid.org/0000-0002-7414-8281> [Accessed 15 February 2023]

Raifman, S., DeVost, M.A., Digitale, J.C., Chen, Y.H. & Morris, M.D. 2022. Respondent-Driven Sampling: A Sampling Method for Hard-to-Reach Populations and Beyond. *Current Epidemiology Reports*, 9:38–47. <https://doi.org/10.1007/s40471-022-00287-8> [Accessed 29 May 2023]

Raja Santhi, A., Muthuswamy, P. 2023. Industry 5.0 or industry 4.0S? Introduction to industry 4.0 and a peek into the prospective industry 5.0 technologies. *International Journal of Interactive Design and Manufacturing*, 17:947–979. <https://doi.org/10.1007/s12008-023-01217-8> [Accessed 10 September 2023]

Raman, R & Sullivan, N. 2024. Integrating Scholarly Evidence and Personal Experience in Health Information Technology-Enabled Evidence-Based Patient-Care Practices: Challenges, Opportunities, and Outcomes. ACM SIGMIS Database: *The DATABASE for Advances in Information Systems*, 55(1):88–135. <https://doi.org/10.1145/3645057.3645063> [Accessed 20 August 2024]

Ramaila, S. & Molwele, A. 2022. The Role of Technology Integration in the Development of 21st Century Skills and Competencies in Life Sciences Teaching and Learning. *International Journal of Higher Education*, 11(5). <https://doi.org/10.9-17.10.5430/ijhe.v11n5p9> [Accessed 11 June 2022]

Ramirez-Avila, M. 2022. Self-Assessment to improve speaking skills: A brief action research. Sapienza: *International Journal of Interdisciplinary Studies*, 3:351-362. <https://doi.org/10.51798/sijis.v3i6.492> [Accessed 2 April 2023]

Ramjan, L.M., Maneze, D., Salamonson, Y., Zugai, J., Bail, K., Liu, X-L. & Montayre, J. 2024. Undergraduate nursing students challenge misconceptions towards men in nursing: A mixed-

method study. *Journal of Advanced Nursing*, 80:1638–1651. <https://doi.org/10.1111/jan.15914> [Accessed 20 July 2024]

Rana, J., Gutierrez, L. & John, P.O. 2021. Quantitative Methods. https://doi.org/10.1007/978-3-319-31816-5_460-1 [Accessed 16 February 2023]

Rasdiana, W.B.B., Imron, A., Rahma, L., Arifah, N., Azhari, R., El4IRa, S.I. & Maharmawan, M.A. 2024. Elevating Teachers' Professional Digital Competence: Synergies of Principals' Instructional E-Supervision, Technology Leadership and Digital Culture for Educational Excellence in Digital-Savvy Era. *Education Sciences*, 14(3):266. <https://doi.org/10.3390/educsci14030266> [Accessed 18 July 2024]

Raustøl, A. & Tveit, B. 2023. Compassion, emotions and cognition: Implications for nursing education. *Nursing Ethics*, 30(1):145-154. <https://doi:10.1177/09697330221128903> [Accessed 10 June 2024]

Ravi, R.K., Baby, P., Pareek, B., George, T.J., Mohamed, M.G. & Ahmed, S.K. 2024. Preferences, Acceptability and Usage of Mobile Health Applications Among Undergraduate Nursing Students: A Multisite, Cross-Sectional Survey. *SAGE Open Nursing*. <https://doi:10.1177/23779608241247431> [Accessed 20 August 2024]

Raykov, T., Marcoulides, G., Anthony, J. & Menold, N. 2024. Evaluating Cronbach's Coefficient Alpha and Testing Its Identity to Scale Reliability: A Direct Bayesian Confirmatory Factor Analysis Procedure. *Measurement: Interdisciplinary Research and Perspectives*, 22(1):78–89. <https://doi.org/10.1080/15366367.2023.2201963> [Accessed 20 July 2024]

Ravikiran, A.S. 2023. Population vs Sample: Definitions, Differences and Examples. <https://www.simplilearn.com/tutorials/machine-learning-tutorial/population-vs-sample> [Accessed 15 September 2023]

Reddy, K., Gharde, P., Tayade, H., Patil, M., Reddy, L.S. & Surya, D. 2024. Advancements in Robotic Surgery: A Comprehensive Overview of Current Utilizations and Upcoming Frontiers. *Cureus*, 15(12): e50415. <https://doi:10.7759/cureus.50415> [Accessed 20 August 2024]

Reis, J. & Melão, N. 2023. Digital transformation: A meta-review and guidelines for future research. *Heliyon*, 9(1): e12834. <https://doi.org/10.1016/j.heliyon.2023.e12834> [Accessed 17 September 2023]

Rekha, S.G. 2020. The future of nursing: leading change, advancing health. *Journal of Paediatrics and Nursing Science*, 3(3):60-63 <https://doi.org/10.18231/j.ijpns.2020.013> [Accessed 28 March 2023]

Renjith, V., Yesodharan, R., Noronha, J.A., Ladd, E. & George, A. 2021. Qualitative Methods in Health Care Research. *International Journal of Preventive Medicine*, 12:20. https://doi:10.4103/ijpvm.IJPVM_321_19 [Accessed 4 September 2023]

Renukappa, S., Mudiya, P., Suresh, S., Abdalla, W. & Subbarao, C. 2022. Evaluation of challenges for adoption of smart healthcare strategies. *Smart Health*, 26:100330. <https://doi.org/10.1016/j.smhl.2022.100330> [Accessed 14 September 2023]

Rettinger, L., Putz, P., Aichinger, L., Javorszky, S.M., Widhalm, K., Ertelt-Bach, V., Huber, A., Sargis, S., Maul, L., Radinger, O., Werner, F. & Kuhn, S. 2024. Telehealth Education in Allied Health Care and Nursing: Web-Based Cross-Sectional Survey of Students' Perceived

Knowledge, Skills, Attitudes, and Experience. *JMIR Medical Education*, 10: e51112. <https://doi.org/10.2196/51112> [Accessed 18 July 2024]

Rezaie, F., Farshbaf, M., Dahri, M., Masjedi, M., Maleki, R., Amini, F., Wirth, J., Moharamzadeh, K., Weber, F.E. & Tayebi, L. 2023. 3D Printing of Dental Prostheses: Current and Emerging Applications. *Journal of Composites Science*, 7(2):80. <https://doi.org/10.3390/jcs7020080> [Accessed 5 June 2023]

Rice, S., Crouse, S.R., Winter, S.R. & Rice, C. 2024. The advantages and limitations of using ChatGPT to enhance technological research. *Technology in Society*, 76:102426. <https://doi.org/10.1016/j.techsoc.2023.102426> [Accessed 20 July 2024]

Rivard, S. 2024. Unpacking the process of conceptual leaping in the conduct of literature reviews. *The Journal of Strategic Information Systems*, 33(1):101822. <https://doi.org/10.1016/j.jsis.2024.101822> [Accessed 15 July 2024]

Rodríguez-Ortega, M., Latorre, Y.O., Navarro, E.M., Collado, A.J.C., Nguepy, F.R. & Damou, F. 2024. Telemedicine as a counselling tool for nurses in Central Africa. *Journal of Advanced Nursing*, 00:1–10. <https://doi.org/10.1111/jan.16406> [Accessed 14 August 2024]

Rodrigues, F., Morouço, P., Antunes, R., Monteiro, D., Jacinto, M., Figueiredo, N., Santos, F., Bastos, V. & Teixeira, D. 2023. Using Psychometric Testing Procedures for Reliability and Invariance Analysis: The PRETIE-Q Portuguese Version. *European Journal of Investigation in Health, Psychology and Education*, (7):1158-1172. <https://doi.org/10.3390/ejihpe13070086> [Accessed 30 August 2023]

Rodríguez-Pérez, M., Mena-Navarro, F., Domínguez-Pichardo, A. & Teresa-Morales, C. 2022. Current Social Perception of and Value Attached to Nursing Professionals' Competences: An Integrative Review. *International Journal of Environmental Research and Public Health*, 19(3):1817. <https://doi.org/10.3390/ijerph19031817> [Accessed 21 November 2023]

Ronaghi, M.H. 2024. Toward a model for assessing smart hospital readiness within the industry 4.0 paradigm. *Journal of Science and Technology Policy Management*, 15(2):353-373. <https://doi.org/10.1108/JSTPM-09-2021-0130> [Accessed 14 July 2024]

Rony, M.K.K., Parvin, M.R. & Ferdousi, S. 2024b. Advancing nursing practice with artificial intelligence: Enhancing preparedness for the future. *Nursing Open*, 11(1). <https://doi.org/10.1002/nop2.2070> [Accessed 29 May 2024]

Rony, M.K.K., Kayesh, I., Das Bala, S., Akter, F. & Parvin, M.R. 2024a. Artificial intelligence in future nursing care: Exploring perspectives of nursing professionals - A descriptive qualitative study, *Heliyon*, 10(4): e25718. <https://doi.org/10.1016/j.heliyon.2024.e25718> [Accessed 29 May 2024]

Rony, M.K.K., Parvin, M.R., Wahiduzzaman, M., Debnath, M., Bala, S.D. & Kayesh, I. 2024c. "I Wonder if my Years of Training and Expertise Will be Devalued by Machines": Concerns About the Replacement of Medical Professionals by Artificial Intelligence. *SAGE Open Nursing*, 10. <https://doi.org/10.1177/23779608241245220> [Accessed 18 July 2024]

Rosário, A.T. & Dias, J.C. 2023. How has data-driven marketing evolved: Challenges and opportunities with emerging technologies. *International Journal of Information Management Data Insights*, 3(2):100203. <https://doi.org/10.1016/j.ijime.2023.100203> [Accessed 13 June 2024]

- Rosenzweig, G. 2022. Scientific Thinking About Legal Truth. *Frontiers in Psychology*, (13). <https://doi.10.3389/fpsyg.2022.918282> [Accessed 18 February 2023]
- Rosenlund, M., Kinnunen, U.M. & Saranto, K. 2023. The Use of Digital Health Services Among Patients and Citizens Living at Home: Scoping Review. *Journal of Medical Internet Research*, 25: e44711. <https://doi.10.2196/44711> [Accessed 29 May 2024]
- Ross, P.T. & Bibler Zaidi, N.L. 2019. Limited by our limitations. *Perspectives of Medical Education*, 8(4):261-264. <https://doi.10.1007/s40037-019-00530-x> [Accessed 11 December 2023]
- Rossi, S., Rossi, M., Mukkamala, R.R., Thatcher, J.B. & Dwivedi, Y.K. 2024. Augmenting research methods with foundation models and generative AI. *International Journal of Information Management*, 77:102749. <https://doi.org/10.1016/j.ijinfomgt.2023.102749> [Accessed 18 July 2024]
- Rost, J.K. 2024. Analyzing Student Success Outcome Variables in Higher Education Utilizing the Chi-Square Test of Independence. *International Journal of Higher Education*, 13(2). <https://doi.org/10.5430/ijhe.v13n2p100> [Accessed 20 July 2024]
- Rota, A. 2024. Utopias for Boomers: religion, psychology, and sovereignty in the long sixties. *Religion*, 54(3):474–493. <https://doi.org/10.1080/0048721X.2024.2362067> [Accessed 15 July 2024]
- Rothlisberger, P.N. 2024. AI-Powered Patient-centered Care: A Call to Action for Innovation. *Journal of Healthcare Management*, 69(4):255-266. <https://doi:10.1097/JHM-D-24-00102> [24 September 2024]
- Rovetta, A., Mansournia, M.A. & Vitale, A. 2024. For a proper use of frequentist inferential statistics in public health. *Global Epidemiology*, 8:100151. <https://doi.org/10.1016/j.gloepi.2024.100151> [Accessed 15 July 2024]
- Rowland, M. & Adefuye, A. 2022. 'Human errors and factors that influence patient safety in the pre-hospital emergency care setting: Perspectives of South African emergency care practitioners. *Health SA Gesondheid*, 27(0): a1798. <https://doi.org/10.4102/hsag.v27i0.1798> [Accessed 22 June 2024]
- Rudberg, S.L., Westerbotn, M., Sormunen, T., Scheja, M. & Lachmann, H. 2022. Undergraduate nursing students' experiences of becoming a Professional Nurse: A longitudinal study. *BMC Nursing*, 21(1):219. <https://doi.10.1186/s12912-022-01002-0> [Accessed 15 July 2024]
- Rusticus, S.A., Pashootan, T. & Mah, A. 2023. What are the key elements of a positive learning environment? Perspectives from students and faculty. *Learning Environments Research*, 26(1):161-175. <https://doi.10.1007/s10984-022-09410-4> [Accessed 13 June 2024]
- Rutledge, C.M. & Gustin, T. 2021. "Preparing Nurses for Roles in Telehealth: Now is the Time!" *OJIN: The Online Journal of Issues in Nursing*, 26(1): Manuscript 3. <https://doi.org/10.3912/OJIN.Vol26No01Man03> [Accessed 24 July 2024]
- Ryan, T., Henderson, M. & Aagaard, J. 2021. The use of digital devices in the classroom. In K-A. Allen, A. Reupert & L. Oades (Eds.), *Building Better Schools with Evidence-based Policy: Adaptable Policy for Teachers and School Leaders*, (1):176-182). Routledge. <https://doi.org/10.4324/9781003025955-24> [Accessed 28 March 2023]

- Sá, M.J. & Serpa, S. 2020. The COVID-19 Pandemic as an Opportunity to Foster the Sustainable Development of Teaching in Higher Education. *Sustainability*, 12(20):8525. <https://doi.org/10.3390/su12208525> [Accessed 24 July 2023]
- Sakhapov, R. & Absalyamova, S. 2018. Fourth industrial revolution and the paradigm change in engineering education. *MATEC Web of Conferences*, 245. <http://dx.doi.org/10.1051/mateconf/201824512003> [Accessed 3 July 2021]
- Saleh, M., Saleh, M., Elsabahy, H. & Abdelhamid, Z. 2023. Information technology as an opportunity for improving nurses' work outcomes in Egypt. <https://srb.sdl.edu.sa/esploro/outputs/journalArticle/Information-technology-as-an-opportunity-for/9929260108331> [Accessed 15 September 2022]
- Sallam, M. 2023. ChatGPT Utility in Healthcare Education, Research, and Practice: Systematic Review on the Promising Perspectives and Valid Concerns. *Healthcare*, 11(6):887. <https://doi.org/10.3390/healthcare11060887> [Accessed 15 October 2023]
- Salman, F.A. 2024. Dynamics of Changes in Literacy Culture in the Social Media Era: Comparative Study of the Millennial Generation and Generation Z. *KnE Social Sciences*, 9(12):627–643. <https://doi.org/10.18502/kss.v9i12.15885> [Accessed 20 July 2024]
- Salter, M.B., Mutlu, C.E. & Frowd, P.M. 2023. Research Methods in Critical Security Studies: An Introduction, 2. Routledge. <https://doi.org/10.4324/9781003108016-3> [Accessed 7 October 2023]
- Salvagno, M., Taccone, F.S. & Gerli, A.G. 2023. Correction to: Can artificial intelligence help for scientific writing?. *Critical Care*, 27(99). <https://doi.org/10.1186/s13054-023-04390-0> [Accessed 12 July 2024]
- Samadhiya, A., Kumar, A., Garza-Reyes, J.A., Luthra, S. & del Olmo García, F. 2024. Unlock the potential: Unveiling the untapped possibilities of blockchain technology in revolutionizing Internet of medical things-based environments through systematic review and future research propositions. *Information Sciences*, 661:120140. <https://doi.org/10.1016/j.ins.2024.120140> [Accessed 10 July 2024]
- Samuels, Peter. (2020). A Really Simple Guide to Quantitative Data Analysis. <https://doi.org/10.13140/RG.2.2.25915.36645> [Accessed 15 February 2023]
- Sánchez-Gutiérrez, C.H., Minnillo, S., Fernández Mira, P. & Hernández, A. 2024. Prompt response variation in learner corpus research: Implications for data interpretation. *Research Methods in Applied Linguistics*, 3(3):100134. <https://doi.org/10.1016/j.rmal.2024.100134> [Accessed 20 July 2024]
- Santric, M.M., Scotter, C.D.P., Bruno-Tome, A., Scheerens, C. & Ellington, K. 2024. Healthcare workforce equity for health equity: an overview of its importance for the level of primary health care. *International Journal of Health Planning and Management*, 39(3):945-955. <https://doi.org/10.1002/hpm.3790> [Accessed 15 July 2024]
- Sarella, P.N.K. & Mangam, V.T. 2024. AI-Driven Natural Language Processing in Healthcare: Transforming Patient-Provider Communication. *Indian Journal of Pharmacy Practice*, 17(1):21-26. <https://www.ijopp.org/> [Accessed 14 August 2024]

Sarma, R., Kumari, K. & Bhui, N. 2024. An Outline on Research in Social Science. *Educational Administration: Theory and Practice*, 30(5):10814–10832. Retrieved from <https://kuey.net/index.php/kuey/article/view/4846> [Accessed 18 July 2024]

Sataloff, R. T. & Vontela, S. 2021. Response Rates in Survey Research. *Journal of voice: Official Journal of the Voice Foundation*, 35(5):683–684. <https://doi.org/10.1016/j.jvoice.2020.12.043> [Accessed 14 February 2023]

Scerri, A. & Morin, K. H. 2023. Using chatbots like ChatGPT to support nursing practice. *Journal of Clinical Nursing*, 32(15-16):4211-4213. <https://doi.org/10.1111/jocn.16677> [Accessed 23 October 2023]

Scharf, F. & Nestler, S. 2019. A comparison of simple structure rotation criteria in temporal exploratory factor analysis for event-related potential data. *Methodology: European Journal of Research Methods for the Behavioral and Social Sciences*, 15(1):43–60. <https://doi.org/10.1027/1614-2241/a000175> [Accessed 3 October 2021]

Schmitt, C.A. & Lancaster, R.J. 2019. Readiness to Practice in Generation Z Nursing Students. *Journal of Nursing Education*, 58(10):604-606. <https://doi.org/10.3928/01484834-20190923-09> [Accessed 16 August 2021]

Schwab, K. 2019. Davos Manifesto 2020: The Universal Purpose of a Company in the Fourth Industrial Revolution. World Economic Forum Web Site. <https://www.weforum.org/agenda/2019/12/why-we-need-the-davos-manifesto-for-better-kind-of-capitalism> [Accessed 2 July 2021]

Schwalbe, D., Timmermann, C., Gregersen, T.A., Steffensen, S.V. & Ammentorp, J. (2024). Communication, Cognition and Competency Development in Healthcare: A Model for Integrating Cognitive Ethnography and Communication Skills Training in Clinical Interventions. *Journal of Medical Education and Curricular Development*, 11. <https://doi.org/10.1177/23821205231223319> [Accessed 15 July 2024]

Scheytt, C. & Pflüger, J. 2024. Conducting Qualitative Research in Organizations Ethically: Organizationally as a Heuristic to Identify Ethical Challenges. *International Journal of Qualitative Methods*, 23. <https://doi.org/10.1177/16094069241237548> [Accessed 15 July 2024]

Schirmer, M., Dalko, K., Stoevesandt, D., Paulicke, D. & Jahn, P. 2023. Educational Concepts of Digital Competence Development for Older Adults-A Scoping Review. *International Journal of Environmental Research and Public Health*, 20(13):6269. <https://doi:10.3390/ijerph20136269> [Accessed 17 September 2023]

Schober, P. & Vetter, T.R. 2020. Nonparametric Statistical Methods in Medical Research. *Anesthesia and Analgesia*, 131(6):1862-1863. <https://doi:10.1213/ANE.0000000000005101> [Accessed 22 September 2023]

Schoormann, T., Möller, F., Chandra Kruse, L. & Otto, B. 2024. BAUSTEIN-a design tools for configuring and representing design research. *Information Systems Journal*, 34(6):1871–1901. <https://doi.org/10.1111/isj.12516> [Accessed 20 September 2024]

Seibert, K., Domhoff, D., Bruch, D., Schulte-Althoff, M., Fürstenau, D., Biessmann, F. & Wolf-Ostermann, K. 2021. Application Scenarios for Artificial Intelligence in Nursing Care: Rapid

Review. *Journal of Medical Internet Research*, 23(11): e26522. <https://doi.org/10.2196/26522> [Accessed 24 June 2024]

Semwal, M., Whiting, P., Bajpai, R., Bajpai, S., Kyaw, B.M. & Tudor-Car, L. 2019. Digital Education for Health Professions on Smoking Cessation Management: Systematic Review by the Digital Health Education Collaboration. *Journal of Medical Internet Research*, 21(3): e13000. <https://doi.org/10.2196/13000> [Accessed 12 August 2021]

Seney, V., Desroches, M.L. & Schuler, M.S. 2023. Using ChatGPT to Teach Enhanced Clinical Judgment in Nursing Education. *Nurse Educator*, 48(3):124. <https://doi.org/10.1097/NNE.0000000000001383> [Accessed 17 September 2023]

Senior, H., Grant, M., Rhee, J.J., Aubin, M., McVey, P., Johnson, C., Monterosso, L., Nwachukwu, H., Fallon-Ferguson, J., Yates, P., Williams, B. & Mitchell, G. 2024. General practice physicians' and nurses' self-reported multidisciplinary end-of-life care: A systematic review. *BMJ Supportive and Palliative Care*, 14(e1): E1-E11. <https://doi.org/10.1136/bmjspcare-2019-001852> [Accessed 12 September 2024]

Seo, K., Tang, J., Roll, I., Fels, S. & Yoon, D. 2021. The impact of artificial intelligence on learner–instructor interaction in online learning. *International Journal of Educational Technology in Higher Education*, 18:54. <https://doi.org/10.1186/s41239-021-00292-9> [Accessed 31 May 2023]

Seray-Wurie, M., Hawker, C. & Chitongo, S. 2020. Innovative Approaches to Nurse Teaching and Learning. In: Cunningham, S. (eds) *Dimensions on Nursing Teaching and Learning*. Springer, Cham. https://doi.org/10.1007/978-3-030-39767-8_6 [Accessed 2 April 2023]

Serbaya, S.H., Khan, A.A., Surbaya, S.H. & Alzahrani, S.M. 2024. Knowledge, Attitude and Practice Toward Artificial Intelligence Among Healthcare Workers in Private Polyclinics in Jeddah, Saudi Arabia. *Advances in Medical Education and Practice*, 15:269-280. <https://doi.org/10.2147/AMEP.S448422> [Accessed 10 June 2024]

Serrano-Guerrero, J., Bani-Doumi, M., Chiclana, F., Romero, F.P. & Olivas, J.A. 2024. How satisfied are patients with nursing care and why? A comprehensive study based on social media and opinion mining. *Informatics for Health and Social Care*, 49(1):14–27. <https://doi.org/10.1080/17538157.2023.2297307> [Accessed 15 July 2024]

Shahzeydi, A., Jazi, Z.H. & Babaei, S. 2024. Exploring the perceptions of nursing internship students and their faculty mentors regarding the complexities and hindrances associated with implementing the nursing process within the clinical setting: An in-depth qualitative investigation. *Heliyon*, 10(11): E31715. <https://doi.org/10.1016/j.heliyon.2024.e31715> [Accessed 15 July 2024]

Shao, Q. 2024. The Spillover Effect of Internet usage on Job Satisfaction in the Digital Era: Evidence from Chinese Individual Survey Data. *Social Science Computer Review*, 0(0). <https://doi.org/10.1177/08944393241263825> [Accessed 24 July 2024]

Shafiq, B., Ali, A. & Iqbal, H. 2024. Perfectionism, mattering and loneliness in young adulthood of Generation-Z. *Heliyon*, 10(1): e23330. <https://doi.org/10.1016/j.heliyon.2023.e23330> [Accessed 24 July 2024]

Sharkiyya, S.H. 2023. Quality communication can improve patient-centred health outcomes among older patients: a rapid review. *BMC Health Services Research*, 23(886). <https://doi.org/10.1186/s12913-023-09869-8> [Accessed 24 September 2024]

- Sharma, V., Feldman, M. & Sharma, R. 2024. Telehealth Technologies in Diabetes Self-management and Education. *Journal of Diabetes Science and Technology*, 18(1):148-158. <https://doi:10.1177/19322968221093078> [Accessed 20 August 2024]
- Sharma, S.K., Al-Wanain, M.I., Alowaidi, M. & Alsaghier, H. 2024. Mobile healthcare (m-Health) based on artificial intelligence in healthcare 4.0. *Expert Systems*, 41(6): e13025. <https://doi.org/10.1111/exsy.13025> [Accessed 14 August 2024]
- Sharma, A., Al-Haidose, A., Al-Asmakh, M. & Abdallah, A.M. 2024. Integrating Artificial Intelligence into Biomedical Science Curricula: Advancing Healthcare Education. *Clinics and Practice*, 14(4):1391-1403. <https://doi.org/10.3390/clinpract14040112> [Accessed 18 July 2024]
- Sharma, S.K., Kalal, N. & Rani, R. 2021. Clinical Practice Readiness of Nursing Graduates. *Clinics Mother Child Health*, 18(4):381. <https://www.walshmedicalmedia.com/open-access/clinical-practice-readiness-of-nursing-graduates-70863.html> [Accessed 15 September 2022]
- Shatz, I. 2024. Assumption-checking rather than (just) testing: The importance of visualization and effect size in statistical diagnostics. *Behavior Research*, 56:826–845. <https://doi.org/10.3758/s13428-023-02072-x> [Accessed 20 July 2024]
- Sheikh, A., Anderson, M., Albala, S., Casadei, B., Franklin, B.D., Richards, M., Taylor, D., Tibble, H. & Mossialos, E. 2021. Health information technology and digital innovation for national learning health and care systems. *Health Policy*, 3(6): E383-E396. [https://doi.org/10.1016/S2589-7500\(21\)00005-4](https://doi.org/10.1016/S2589-7500(21)00005-4) [Accessed 13 June 2024]
- Shelley, D., Davis, D., Bail, K., Heland, R. & Paterson, C. 2024. Oncology Nurses' Experiences of Using Health Information Systems in the Delivery of Cancer Care in a Range of Care Settings: A Systematic Integrative Review. *Seminars in Oncology Nursing*, 40(2):151579. <https://doi.org/10.1016/j.soncn.2023.151579> [Accessed 14 July 2024]
- Shen, H-C., Li, C-C. & Yeh, S-C.J. 2024. Do hospitals attaining public recognition for treating nurses fairly deliver better-quality health care? Evidence from cross-sectional analysis of California hospitals. *Journal of Advanced Nursing*. <https://doi.org/10.1111/jan.16123> [Accessed 15 July 2024]
- Sherwood, G. 2021. Quality and safety education for nurses: making progress in patient safety, learning from COVID-19. *International Journal of Nursing Sciences*, 8:249–251. <https://doi:10.1016/j.ijnss.2021.05.009> [Accessed 24 June 2024]
- Shirmatov, S.T. & Akhmedova, G.M. 2024. Revolutionizing Language Learning with Smart Technologies. *Excellencia: International Multi-Disciplinary Journal of Education*, 2(6):1165-1179. <https://doi.org/10.5281/> [Accessed 15 July 2024]
- Shojaei, P., Vlahu-Gjorgievska, E. & Chow, Y-W. 2024. Security and Privacy of Technologies in Health Information Systems: A Systematic Literature Review. *Computers*, 13(2):41. <https://doi.org/10.3390/computers13020041> [Accessed 29 May 2024]
- Shreffler, J. & Huecker, M.R. 2023. Types of Variables and Commonly Used Statistical Designs. In StatPearls. Treasure Island (FL): StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK557882/> [Accessed 11 September 2022]

- Shrestha, R. 2024. Ethical Protocols in Non-Positivist Research Traditions. *International Journal of Multidisciplinary Educational Research and Innovation*, 2(2):59-76. <https://doi.org/10.17613/d4j2-h672> [Accessed 20 July 2024]
- Shrestha, N. 2021. Factor Analysis as a Tool for Survey Analysis. *American Journal of Applied Mathematics and Statistics*, 9:4-11. <https://doi.org/10.12691/ajams-9-1-2> [Accessed 29 May 2023]
- Shukla, D. 2023. A narrative review on types of data and scales of measurement: An initial step in the statistical analysis of medical data. *Cancer Research, Statistics, and Treatment*, 6(2):279-283. https://doi:10.4103/crst.crst_1_23 [Accessed 15 September 2023]
- Siala, H. & Wang, Y. 2022. Shifting artificial intelligence to be responsible in healthcare: A systematic review. *Social Science & Medicine*, 296:114782. <https://doi.org/10.1016/j.socscimed.2022.114782> [Accessed 15 October 2023]
- Sibbald, S.L., Paciocco, S., Fournie, M., Van Asseldonk, R. & Scurr, T. 2021. Continuing to enhance the quality of case study methodology in health services research. *Healthcare Management Forum*, 34(5):291-296. <https://doi:10.1177/08404704211028857> [Accessed 12 June 2024]
- Siddiqi, M., Greene, M.E., Stoppel, A. & Allegar, C. 2024. Interventions to Address the Health and Well-Being of Married Adolescents: A Systematic Review. *Global Health: Science and Practice*, <https://doi.org/10.9745/GHSP-D-23-00425> [Accessed 20 July 2024]
- Siegel, J. & Jones, N. 2018. Survey Methods. <http://dx.doi.org/10.4135/9781506326139.n678> [Accessed 11 September 2023]
- Siekmann, F., Schlör, H. & Venghaus, S. 2023. Linking sustainability and the Fourth Industrial Revolution: a monitoring framework accounting for technological development. *Energy Sustainability and Society*, 13:26. <https://doi.org/10.1186/s13705-023-00405-4> [Accessed 17 September 2023]
- Sigudla, J. & Maritz, J.E. 2023. Exploratory factor analysis of constructs used for investigating research uptake for public healthcare practice and policy in a resource-limited setting, South Africa. *BMC Health Services Research*, 23:1423. <https://doi.org/10.1186/s12913-023-10165-8> [Accessed 27 July 2024]
- Sim, J.J.M., Rusli, K.D.B., Seah, B., Levett-Jones, T., Lau, Y. & Liaw, S.Y. 2022. Virtual Simulation to Enhance Clinical Reasoning in Nursing: A Systematic Review and Meta-analysis. *Clinical Simulation in Nursing*, 69:26-39. <https://doi:10.1016/j.ecns.2022.05.006> [Accessed 13 June 2024]
- Sim, J., Waterfield, J. 2019. Focus group methodology: some ethical challenges. *Quality & Quantity*, 53:3003–3022. <https://doi.org/10.1007/s11135-019-00914-5> [Accessed 29 May 2023]
- Simões, S., Oliveira, T. & Nunes, C. 2022. Influence of computers in students' academic achievement. *Heliyon*, 8:3. <https://doi.org/10.1016/j.heliyon.2022.e09004> [Accessed 27 May 2023]
- Sindermann, C., Kannen, C. & Montag, C. 2024. The degree of heterogeneity of news consumption in Germany—Descriptive statistics and relations with individual differences in

personality, ideological attitudes, and voting intentions. *New Media & Society*, 26(2):711-731. <https://doi.org/10.1177/14614448211061729> [Accessed 20 July 2024]

Singaram, S., Meyer, C-H. & Oosthuizen, R.M. 2023. Leading higher education into the fourth industrial revolution: an empirical investigation. *Frontiers in Psychology*, 14:1242835. <https://doi.org/10.3389/fpsyg.2023.1242835> [15 September 2023]

Singh, R. 2021. Information Communication Technology. <https://www.semanticscholar.org/paper/Information-Communication-Technology-in-Education-Singh/a4803c1f7244a5f92390a60d2098b1c401266cfe> [Accessed 10 February 2022]

Singh, F.M. & Masango, T. 2020. Information Technology in Nursing Education: Perspectives of Student Nurses. *The Open Nursing Journal*, 14:18-28. <https://doi.org/10.2174/1874434602014010018> [Accessed 29 May 2023]

Siregar, K.E. 2024. Increasing Digital Literacy in Education: Analysis of Challenges and Opportunities Through Literature Study. *International Journal of Multilingual Education and Applied Linguistics*, 1(2):10–25. <https://doi.org/10.61132/ijmeal.v1i2.18> [Accessed 20 July 2024]

Smith, C.M., Horne, C.E. & Wei, H. 2024. Nursing practice in modern healthcare environments: A systematic review of attributes, characteristics, and demonstrations. *Journal of Advanced Nursing*, 0(00). <https://doi.org/10.1111/jan.16088> [Accessed 20 July 2024]

Snyder, H. 2019. Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104:333-339. <https://doi.org/10.1016/j.jbusres.2019.07.039> [Accessed 1 June 2023]

Snyder, H. 2023. Designing the literature review for a strong contribution. *Journal of Decision Systems*. <https://doi.org/10.1080/12460125.2023.2197704> [Accessed 4 September 2023]

Sommer, D., Kasbauer, J., Jakob, D., Schmidt, S. & Wahl, F. 2024. Potential of Assistive Robots in Clinical Nursing: An Observational Study of Nurses' Transportation Tasks in Rural Clinics of Bavaria, Germany. *Nursing Reports*, 14(1):267-286. <https://doi.org/10.3390/nursrep14010021> [Accessed 24 September 2024]

Sony, M., Antony, J. & Tortorella, G.L. 2023. Critical Success Factors for Successful Implementation of Healthcare 4.0: A Literature Review and Future Research Agenda. *International Journal of Environmental Research and Public Health*, 20(5):4669. <https://doi.org/10.3390/ijerph20054669> [Accessed 22 July 2024]

Sönmez, S. 2018. 11 Steps Process as A Research Method. *Universal Journal of Educational Research*, 6(11):2597-2603. <https://doi.org/10.13189/ujer.2018.061125> [Accessed 10 February 2023]

Sönning, L., Krug, M., Vetter, F., Schmid, T., Leucht, A. & Messer, P. 2024. Latent-Variable Modelling of Ordinal Outcomes in Language Data Analysis. *Journal of Quantitative Linguistics*, 31(2):77–106. <https://doi.org/10.1080/09296174.2024.2329448> [Accessed 20 July 2024]

Soriano, G.P., Yasuhara, Y., Ito, H., Matsumoto, K., Osaka, K., Kai, Y., Locsin, R., Schoenhofer, S. & Tanioka, T. 2022. Robots and Robotics in Nursing. *Healthcare*, 10(8):1571. <https://doi.org/10.3390/healthcare10081571> [Accessed 13 June 2024]

Sperling, K., Stenberg, C.-J., McGrath, C., Åkerfeldt, A., Heintz, F. & Stenliden, L. 2024. In search of artificial intelligence (AI) literacy in teacher education: A scoping review. *Computers and Education Open*, 6:100169. <https://doi.org/10.1016/j.caeo.2024.100169> [Accessed 18 July 2024]

Staddon, R.V. 2020. Bringing technology to the mature classroom: age differences in use and attitudes. *International Journal of Educational Technology in Higher Education*, 17(11). <https://doi.org/10.1186/s41239-020-00184-4> [Accessed 29 May 2024]

Stevenson, N., Innes, R.J., Gronau, Q.F., Miletić, S., Heathcote, A., Forstmann, B.U. & Brown, S.D. 2024. Using group level factor models to resolve high dimensionality in model-based sampling. *Psychological Methods*. Advance online publication. <https://doi.org/10.1037/met0000618> [Accessed 20 July 2024]

Stirling, N.S.J. & Takarangi, M.K.T. 2024. The participant's voice: crowdsourced and undergraduate participants' views toward ethics consent guidelines. *Ethics & Behavior*. Advanced online publication. <https://doi.org/10.1080/10508422.2024.2341639> [Accessed 20 July 2024]

Stoumpos, A.I., Kitsios, F. & Talias, M.A. 2023. Digital Transformation in Healthcare: Technology Acceptance and Its Applications. *International Journal of Environmental Research and Public Health*, 20(4):3407. <https://doi.org/10.3390/ijerph20043407> [Accessed 5 September 2023]

Streefkerk, R. 2022. Internal vs. External Validity: Understanding Differences & Threats. Scribbr. <https://www.scribbr.com/methodology/internal-vs-external-validity/> [Accessed 9 March 2023]

Streefkerk, R. 2023. Qualitative vs. Quantitative Research | Differences, Examples & Methods. Scribbr. <https://www.scribbr.com/methodology/qualitative-quantitative-research/> [Accessed 11 February 2023]

Strudwick, G., Booth, R.G., Bjarnadottir, R.I., Rossetti, S.C., Friesen, M., Sequeira, L., Munnery, M. & Srivastava, R. 2019. The Role of Nurse Managers in the Adoption of Health Information Technology: Findings from a Qualitative Study. *Journal of Nursing Administration*, 49(11):549-555. <https://doi.org/10.1097/NNA.0000000000000810> [Accessed 8 January 2024]

Suárez-García, A., Álvarez-Hernández, M., Arce, E. & Ribas, J.R. 2024. Exploring the Efficacy of Binary Surveys versus Likert Scales in Assessing Student Perspectives Using Bayesian Analysis. *Applied Sciences*, 14(10):4189. <https://doi.org/10.3390/app14104189> [Accessed 20 July 2024]

Subbiah, V. 2023. The next generation of evidence-based medicine. *Nature Medicine*, 29:49–58. <https://doi.org/10.1038/s41591-022-02160-z> [Accessed 17 September 2023]

Suchkov, S., Scherman, D., Bonifazi, D., Antonova, E., Murphy, S., Kovalev, M., Dunning, T., Blokh, S., Smith, D. & Abe5, H. 2024. Personalized and Precision Medicine (PPM) as a Unique Healthcare Model of the Next Step Generation: The role of a Nurses and Nursing Practice in Transdisciplinary Care Team: *The Future of Nursing Services*, 1(1):1-13. <https://doi.org/10.61440/JMCNS.2024.v2.38> [Accessed 15 July 2024]

Sullivan, M., Kelly, A. & McLaughlan, P. 2023. ChatGPT in higher education: Considerations for academic integrity and student learning. *Journal of Applied Teaching & Learning*, 6(1). <https://doi.org/10.37074/jalt.2023.6.1.17> [Accessed 17 September 2023]

Sun, P. & Zuo, X. 2024. Philosophical Foundations of Management Research: A Comprehensive Review. *Journal of Scientific Reports*, 6(1):1-22. <https://doi.org/10.58970/JSR.1028> [Accessed 18 July 2024]

Sun, Y., Yin, Y., Wang, J., Ding, Z., Wang, D., Zhang, Y., Zhang, J. & Wang, Y. 2023. Critical thinking abilities among newly graduated nurses: A cross-sectional survey study in China. *Nursing Open*, 10(3):1383-1392. <https://doi.org/10.1002/nop2.1388> [Accessed 17 September 2023]

Sunnasy, A. & van der Heever, M. 2024. Technology-Mediated Education: The Lived Experiences of Nurse Educators. Available at SSRN: <https://ssrn.com/abstract=4744847> or <http://dx.doi.org/10.2139/ssrn.4744847> [Accessed 10 July 2024]

Swart, L. A., Kramer, S., Ratele, K. & Seedat, M. 2019. Non-experimental research designs: Investigating the spatial distribution and social ecology of male homicide. *Research Methods in the Social Sciences*, 19. <https://doi.org/10.18772/22019032750.7> [Accessed 12 August 2021]

Syed-Abdul, S. & Li, Y.C. 2023. Empowering Patients and Transforming Healthcare in the Post-COVID-19 Era: The Role of Digital and Wearable Technologies. *Journal of Personalised Medicine*, 13(5):722. <https://doi.org/10.3390/jpm13050722> [Accessed 24 September 2024]

Tabasi, M., Rose, J.M., Pellegrini, A. & Rashidi, T.H. 2024. An empirical investigation of the distribution of travelers' willingness-to-pay: A comparison between a parametric and nonparametric approach. *Transport Policy*, 146:312-321. <https://doi.org/10.1016/j.tranpol.2023.12.006> [Accessed 20 July 2024]

Taber, K. 2018. The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education*, 48:1-24. <https://doi.org/10.1007/s11165-016-9602-2> [Accessed 9 October 2021]

Taecharungroj, V. 2023. "What Can ChatGPT Do?" Analyzing Early Reactions to the Innovative AI Chatbot on Twitter. *Big Data and Cognitive Computing*, 7(1):35. <https://doi.org/10.3390/bdcc7010035> [Accessed 17 September 2023]

Taherdoost, H. 2020. Different Types of Data Analysis; Data Analysis Methods and Techniques in Research Projects. *International Journal of Academic Research in Management*, 9(1):1-9. <https://hal.science/hal-03741837> [Accessed 11 September 2022]

Taherdoost, H. 2021. Data Collection Methods and Tools for Research: A Step-by-Step Guide to Choose Data Collection Technique for Academic and Business Research Projects. *International Journal of Academic Research in Management (IJARM)*, 10(1):10-38. [https://10\(1\):10-38.ffhal-03741847f](https://10(1):10-38.ffhal-03741847f) [Accessed 11 September 2022]

Tamilarasi, B., Kanimozhi, M. & Jocelyn, J.J. 2024. Impact of e-training module on students' readiness to learn in technology enhanced environment among students in selected college of nursing. *International Journal of Midwifery and Nursing Practice*, 6(2):87-90. <https://doi.org/10.33545/26630427.2023.v6.i2b.148> [Accessed 18 July 2024]

Tan, A.J., Rusli, K.D., McKenna, L., Tan, L.L. & Liaw, S.Y. 2024. Telemedicine experiences and perspectives of healthcare providers in long-term care: A scoping review. *Journal of Telemedicine and Telecare*, 30(2):230-249. <https://doi.org/10.1177/1357633X211049206> [Accessed 15 July 2024]

Tanujaya, B., Prahmana, R.C.I. & Mumu, J. 2023. Likert Scale in Social Sciences Research: Problems and Difficulties. *FWU Journal of Social Sciences*, 16:89-101. <https://10.51709/19951272/Winter2022/7> [Accessed 10 June 2024]

Taquette, S.R. & Borges da Matta Souza, L.M. 2022. Ethical Dilemmas in Qualitative Research: A Critical Literature Review. *International Journal of Qualitative Methods*, 21. <https://doi.org/10.1177/16094069221078731> [Accessed 22 September 2023]

Tariq, R.A., Vashisht, R., Sinha, A & Yevgeniya, S. 2023. Medication Dispensing Errors and Prevention. In StatPearls. Treasure Island (FL): StatPearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK519065/> [Accessed 15 September 2022]

Tahsin, F., Armas, A., Kirakalaprathapan, A., Kadu, M., Sritharan, J., Steele. & Gray, C. 2023. Information and Communications Technologies Enabling Integrated Primary Care for Patients with Complex Care Needs: Scoping Review. *Journal of Medical Internet Research*, 25: e44035. <https://doi:10.2196/44035> [Accessed 16 July 2024]

Tavakol, M. & Wetzel, A. 2020. Factor Analysis: a means for theory and instrument development in support of construct validity. *International Journal of Medical Education*, 11:245-247. <https://doi:10.5116/ijme.5f96.0f4a> [Accessed 30 August 2023]

Tawash, E., Cowman, S. & Anwar, M. 2024. Newly graduates nurses' readiness for practice, transition and integration into the workplace: A longitudinal study with mixed methods research. *Nurse Education in Practice*, 79:104076. <https://doi.org/10.1016/j.nepr.2024.104076> [Accessed 20 July 2024]

Taylor, B. & McLean, G. 2024. Exploring the use of mobile translation applications for culturally and linguistically diverse patients during medical imaging examinations in Australia – a systematic review. *Journal of Medical Radiation Sciences*, 0(00). <https://doi.org/10.1002/jmrs.755> [Accessed 24 July 2024]

Tegegne, M.D., Tilahun, B., Mamuye, A., Kerie, H., Nurhussien, F., Zemen, E., Mebratu, A., Sisay, G., Getachew, R., Gebeyehu, H., Seyoum, A., Tesfaye, S. & Yilma, T.M. 2023. Digital literacy level and associated factors among health professionals in a referral and teaching hospital: An implication for future digital health systems implementation. *Frontiers in Public Health*, 11:1130894. <https://doi:10.3389/fpubh.2023.1130894> [Accessed 31 May 2023]

Temsah, M.H., Aljamaan, F., Malki, K.H., Alhasan, K., Altamimi, I., Aljarbou, R., Bazuhair, F., Alsubaihini, A., Abdulmajeed, N., Alshahrani, F.S., Temsah, R., Alshahrani, T., Al-Eyadhy, L., Alkhateeb, S.M., Saddik, B., Halwani, R., Jamal, A., Al-Tawfiq, J.A. & Al-Eyadhy, A. 2023. ChatGPT and the Future of Digital Health: A Study on Healthcare Workers' Perceptions and Expectations. *Healthcare*, 11(13):1812. <https://doi:10.3390/healthcare11131812> [Accessed 10 June 2024]

Tennant, K., Long, A. & Toney-Butler, T.J. 2023. Active Listening. In StatPearls Treasure Island (FL): StatPearls Publishing. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK442015/> [Accessed 11 September 2022]

Tenny, S., Brannan, J.M. & Brannan, G. D. 2022. Qualitative Study. In StatPearls. StatPearls Publishing. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK470395/> [Accessed 11 February 2023]

Teixeira, L., Cardoso, I., Oliveira, E., Sá, J. & Madeira, F. 2023. Are Health Information Systems Ready for the Digital Transformation in Portugal? Challenges and Future Perspectives. *Healthcare*, 11(5):712. <https://doi:10.3390/healthcare11050712> [Accessed 17 September 2023]

- Thakur, H. 2021. Research Methodology WRITING A RESEARCH REPORT. https://www.researchgate.net/publication/354533791_Research_Methodology_WRITING_A_RESEARCH_REPORT/citation/download [Accessed 13 October 2022]
- South African Government Gazette. 2013. Gazette No. 37067. The Protection of Personal Information Act 4 of 2013 (POPIA). Pretoria: Government Printers. <https://www.gov.za/documents/protection-personal-information-act>. [Accessed 23 November 2021]
- Theofanidis, D. & Fountouki, A. 2019. Limitations And Delimitations in The Research Process. *Perioperative nursing (GORNA)*, 7(3):155–162. <http://doi.org/10.5281/zenodo.2552022> [Accessed 21 December 2023]
- Thielmann, R.R.L.C., Hoving, C., Cals, J.W.L & Crutzen, R. 2023. The Effects of Online Access to General Practice Medical Records Perceived by Patients: Longitudinal Survey Study. *Journal of Medical Internet Research*, 25: e47659. <https://doi:10.2196/47659> [Accessed 17 November 2023]
- Thijssen, J., Tian, Z. & Telea, A. 2024. Interactive tools for explaining multidimensional projections for high-dimensional tabular data, *Computers & Graphics*, 122:103987. <https://doi.org/10.1016/j.cag.2024.103987> [Accessed 20 July 2024]
- Thomas, R.M., Nair, S., Benny, M.J. & Almeida, S.M. 2024. Comparative Analysis of Investment Behavior: Exploring Investment Patterns and Decision-Making between Generation X, Generation Y, and Generation Z. *Management Journal for Advanced Research*, 4(2):21–35. <https://doi.org/10.5281/zenodo.10937791> [Accessed 20 July 2024]
- Thomas, E.E., Taylor, M.L., Ward, E.C., Hwang, R., Cook, R., Ross, J-A., Webb, C., Harris, M., Hartley, C., Carswell, P., Burns, C.L. & Caffery, L.J. 2024. Beyond forced telehealth adoption: A framework to sustain telehealth among allied health services. *Journal of Telemedicine and Telecare*, 30(3):559-569. <https://doi:10.1177/1357633X221074499> [Accessed 14 July 2024]
- Thomas, L.T., Lee, C.M.Y., McClelland, K., Nunis, G., Robinson, S. & Norman, R. 2023. Health workforce perceptions on telehealth augmentation opportunities. *BMC Health Services Research*, 23:182. <https://doi.org/10.1186/s12913-023-09174-4> [Accessed 15 September 2023]
- Thonon, F., Perrot, S., Yergolkar, A.V., Rousset-Torrente, O., Griffith, J.W., Chassany, O. & Duracinsky, M. 2021. Electronic Tools to Bridge the Language Gap in Health Care for People Who Have Migrated: Systematic Review. *Journal of Medical Internet Research*, 23(5): e25131. <https://doi:10.2196/25131> [Accessed 13 June 2024]
- Thumvichit, A. 2024. "Illuminating insights into subjectivity: Q as a methodology in applied linguistics research" *Applied Linguistics Review*, 15(2):531-554. <https://doi.org/10.1515/applirev-2021-0205> [Accessed 18 July 2024]
- Tia, T.C., Cosma, S.A. & Borza, H.V. 2024. Elderhood and the Sacrament of Communion: An Orthodox Theological Exploration of Gracefully Aging. *Religions*, 15(3):304. <https://doi.org/10.3390/rel15030304> [Accessed 20 July 2024]
- Tischendorf, T., Heitmann-Möller, A., Ruppert, S-N., Marchwacka, M., Schaffrin, S., Schaal, T. & Hasseler, M. 2024a. Sustainable integration of digitalisation in nursing education—an

international scoping review. *Frontiers in Health Services*, 4:1344021.

<https://doi:10.3389/frhs.2024.1344021> [Accessed 24 July 2024]

Tischendorf, T., Hasseler, M., Schaal, T., Ruppert, S.-N., Marchwacka, M., Heitmann-Möller, A. & Schaffrin, S. 2024b. Developing digital competencies of nursing professionals in continuing education and training – a scoping review. *Frontiers in Medicine*, 11:1358398.

<https://doi:10.3389/fmed.2024.1358398> [Accessed 15 July 2024]

Timotheou, S., Miliou, O., Dimitriadis, Y., Sobrino, S.V., Giannoutsou, N., Cachia, R., Monés, A.M. & Ioannou, A. 2023. Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Education and Information Technology* (Dordr), 28(6):6695-6726. <https://doi:10.1007/s10639-022-11431-8> [Accessed 13 June 2024]

Tolu-Akinnawo, O., Ezekwueme, F. & Awoyemi, T. 2024. Telemedicine in Cardiology: Enhancing Access to Care and Improving Patient Outcomes. *Cureus*, 16(6): e62852.

<https://doi:10.7759/cureus.62852> [Accessed 24 July 2024]

Tomaszewski, L.E., Zarestky, J. & Gonzalez, E. 2020. Planning Qualitative Research: Design and Decision Making for New Researchers. *International Journal of Qualitative Methods*, 19.

<https://doi.org/10.1177/1609406920967174> [Accessed 4 September 2023]

Trainum, K., Liu, J., Hauser, E. & Xie, B. 2024. Nursing Staff's Attitudes, Needs, and Preferences for Care Robots in Assisted Living Facilities: A Systematic Literature Review. In Companion of the 2024 ACM/IEEE International Conference on Human-Robot Interaction (HRI '24). *Association for Computing Machinery*, New York, NY, USA:1058–1062.

<https://doi.org/10.1145/3610978.3640690> [Accessed 14 August 2024]

Tran, J. 2023. Maximizing your Learning Potential: How to use ChatGPT as a Nursing Student.

LinkedIn. <https://www.linkedin.com/pulse/maximizing-your-learning-potential-how-use-chatgptnursing-tran/> [Accessed 23 October 2023]

Tsafati, B. & Cojocar, D. 2023. Introducing Computerized Technology to Nurses: A Model Based on Cognitive Instrumental and Social Influence Processes. *Healthcare*, 11(12):1788.

<https://doi:10.3390/healthcare11121788> [Accessed 30 August 2023]

Tsafati, B. & Cojocar, D. 2022. "The Importance of Receiving Training in Computerized Technology for Nurses to Maintain Sustainability in the Health System" *Sustainability*, 14(23):15958. <https://doi.org/10.3390/su142315958> [Accessed 11 November 2023]

Tudor Car, L., Dhinakaran, D.A., Kyaw, B.M., Kowatsch, T., Joty, S., Theng, Y.L. & Atun, R. 2020. Conversational Agents in Health Care: Scoping Review and Conceptual Analysis. *Journal of Medical Internet Research*, 22(8): e17158. <https://doi:10.2196/17158> [Accessed 24 September 2024]

Turner, A. 2022. What Are the Top 5 Automation Trends for 2023?

<https://emag.directindustry.com/2022/11/02/automation-trends-artificial-intelligence-cobots-agv-mobile-robots-predictive-maintenance/> [Accessed 6 September 2023]

Turney, S. 2023. Chi-Square (χ^2) Tests | Types, Formula & Examples. Scribbr.

<https://www.scribbr.com/statistics/chi-square-tests/> [Accessed 22 September 2023]

- Tutz, G. 2023. Probability and non-probability samples: Improving regression modeling by using data from different sources. *Information Sciences*, 621:424-436.
<https://doi.org/10.1016/j.ins.2022.11.032> [Accessed 14 February 2023]
- Tzimas, D.E. & Demetriadis, S.N. 2024. Impact of Learning Analytics Guidance on Student Self-Regulated Learning Skills, Performance, and Satisfaction: A Mixed Methods Study. *Education Sciences*, 14(1):92. <https://doi.org/10.3390/educsci14010092> [Accessed 18 July 2024]
- Underdahl, L., Ditri, M. & Duthely, L.M. 2024. Physician Burnout: Evidence-Based Roadmaps to Prioritizing and Supporting Personal Wellbeing. *Journal of Healthcare Leadership*, 16:15–27.
<https://doi.org/10.2147/JHL.S389245> [Accessed 18 July 2024]
- Urio, P.J. & Nziku, C.N. 2024. Career Pathways: Studying the Factors Influencing Career Choice and Change Among Graduate Students in Dar es Salaam, Tanzania. *International Journal of Educational Reform*, 0(0). <https://doi.org/10.1177/10567879231222864> [Accessed 20 July 2024]
- Yamin, M. 2019. Information technologies of the 21st century and their impact on the society. *International Journal of Information Technology*, 11:759–766. <https://doi.org/10.1007/s41870-019-00355-1> [Accessed 27 March 2023]
- Yang, F. & Gu, S. 2021. Industry 4.0, a revolution that requires technology and national strategies. *Complex Intelligence System*, 7:1311–1325. <https://doi.org/10.1007/s40747-020-00267-9> [Accessed 22 May 2023]
- Yellapu, V. 2018. Descriptive statistics. *International Journal of Academic Medicine*, 4:60.
https://doi.org/10.4103/IJAM.IJAM_7_18 [Accessed 11 September 2023]
- Yogesh, M.J. & Karthikeyan, J. 2022. Health Informatics: Engaging Modern Healthcare Units: A Brief Overview. *Frontiers in Public Health*, 10:854688. <https://doi:10.3389/fpubh.2022.854688> [Accessed 14 September 2023]
- van den Hout, J.J.J. & Davis, O.C. 2022. Promoting the Emergence of Team Flow in Organizations. *International Journal of Applied Positive Psychology*, 7:143–189.
<https://doi.org/10.1007/s41042-021-00059-7> [Accessed 10 September 2022]
- van Houwelingen, T., Meeuse, A.C.M. & Kort, H.S.M. 2024. Enabling nurses' engagement in the design of healthcare technology – Core competencies and requirements: A qualitative study. *International Journal of Nursing Studies Advances*, 6:100170.
<https://doi.org/10.1016/j.ijnsa.2023.100170> [Accessed 22 June 2024]
- Varkey, B. Principles of Clinical Ethics and Their Application to Practice. *Medical Principles and Practice*, 30(1):17-28. <https://doi:10.1159/000509119> [Accessed 24 September 2023]
- Varpio, L. & MacLeod, A. 2020. Philosophy of Science Series: Harnessing the Multidisciplinary Edge Effect by Exploring Paradigms, Ontologies, Epistemologies, Axiologies, and Methodologies. *Academic Medicine*, 95(5):686-689. <https://doi:10.1097/ACM.0000000000000314> [Accessed 20 July 2024]
- Varsha, P.S., Chakraborty, A. & Kar, A.K. 2024. How to Undertake an Impactful Literature Review: Understanding Review Approaches and Guidelines for High-impact Systematic Literature Reviews. *South Asian Journal of Business and Management Cases*, 13(1):18-35.
<https://doi.org/10.1177/22779779241227654> [Accessed 15 July 2024]

- Vasileiou, K., Barnett, J., Thorpe, S. & Young, T. 2018. Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. *BMC Medical Research Methodology*, 18:148. <https://doi.org/10.1186/s12874-018-0594-7> [Accessed 13 June 2024]
- Vasquez, B., Moreno-Lacalle, R., Soriano, G.P., Juntasoopeepun, P., Locsin, R.C. & Evangelista, L.S. 2023. Technological machines and artificial intelligence in nursing practice. *Nursing & Health Sciences*, 25(3):474-481. <https://doi:10.1111/nhs.13029> [Accessed 5 September 2023]
- Verma, N., Buch, B., Pandya, R.S., Taralekar, R., Masand, I., Rangparia, H., Katira, J.M. & Acharya, S. 2024. Evaluation and significance of a digital assistant for patient history-taking and physical examination in telemedicine. *Oxford Open Digital Health*, 2: oqae008. <https://doi.org/10.1093/oodh/oqae008> [Accessed 24 July 2024]
- Victoria, A. 2020. Information Technology. <https://doi.org/10.13140/RG.2.2.15684.78728> [Accessed 6 September 2023]
- Viertiö, S., Kiviruusu, O., Piirtola, M., Kaprio, J., Korhonen, T., Marttunen, M. & Suvisaari, S. 2021. Factors contributing to psychological distress in the working population, with a special reference to gender difference. *BMC Public Health*, 21:611. <https://doi.org/10.1186/s12889-021-10560-y> [Accessed 29 May 2023]
- Visalli, M., Béno, N., Nicolle, L. & Schlich, P. 2023. Assessment of the validity and reliability of temporal sensory evaluation methods used with consumers on controlled stimuli delivered by a gustometer. *Food Quality and Preference*, 110:104942. <https://doi.org/10.1016/j.foodqual.2023.104942> [Accessed 30 August 2023]
- Vitazkova, D., Foltan, E., Kosnacova, H., Micjan, M., Donoval, M., Kuzma, A., Kopani, M. & Vavrinsky, E. 2024. Advances in Respiratory Monitoring: A Comprehensive Review of Wearable and Remote Technologies. *Biosensors*, 14(2):90. <https://doi.org/10.3390/bios14020090> [Accessed 24 July 2024]
- Wagino, W., Maksum, H., Purwanto, W., Simatupang, W., Lapis, R. & Indrawan, E. 2024. Enhancing Learning Outcomes and Student Engagement: Integrating E-Learning Innovations into Problem-Based Higher Education. *International Journal of Interactive Mobile Technologies*, 18(10):106. <https://doi:10.3991/ijim.v18i10.47649> [Accessed 10 July 2024]
- Wagiran, W., Suharjana, S., Nurtanto, M. & Mutohahari, F. 2022. Determining the e-learning readiness of higher education students: A study during the COVID-19 pandemic, *Heliyon*, 8(10). <https://doi.org/10.1016/j.heliyon.2022.e11160> [Accessed 14 September 2023]
- Walter, Y. 2024. Embracing the future of Artificial Intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education. *International Journal of Educational Technology in Higher Education*, 21(5). <https://doi.org/10.1186/s41239-024-00448-3> [Accessed 12 June 2024]
- Walton, D.M., Nazari, G., Bobos, P. & MacDermid, J.C. 2023. Exploratory and confirmatory factor analysis of the new region generic version of Fremantle Body Awareness—General Questionnaire. *PLoS ONE*, 18(3): e0282957. <https://doi.org/10.1371/journal.pone.0282957> [Accessed 15 September 2023]

Wang, W., Khelfaoui, I., Ahmed, D., Xie, Y., Hafeez, M. & Meskher, H. 2024. Nexus between information and communication technologies and life expectancies of low-income countries: Does technological advancement increase their life span? *SSM - Population Health*, 25:101600. <https://doi.org/10.1016/j.ssmph.2023.101600> [Accessed 18 July 2024]

Wang, X., Mu, M., Yan, J., Han, B., Ye, R. & Guo, G. 2024. 3D Printing Materials and 3D Printed Surgical Devices in Oral and Maxillofacial Surgery: Design, Workflow and Effectiveness. *Regenerative Biomaterials*, rbae066. <https://doi.org/10.1093/rb/rbae066> [Accessed 24 July 2024]

Wang, M.C., Tang, J.S., Liu, Y.P., Chuang, C.C. & Shih, C.L. 2023. Innovative digital technology adapted in nursing education between Eastern and Western countries: a mini review. *Frontiers in Public Health*, 11:1167752. <https://doi:10.3389/fpubh.2023.1167752> [Accessed 14 September 2023]

Wani, T.A., Jan, S., Tyagi, N., Firdous, A. & Dar, T.A. 2024. Technology readiness index and related customer segmentation: a study of conflict zones. *International Journal of Technology Marketing*, 18(2). <https://dx.doi.org/10.1504/IJTMKT.2024.137677> [Accessed 20 July 2024]

Warren, S., Claman, D., Meyer, B., Peng, J. & Sezgin, E. 2024. Acceptance of voice assistant technology in dental practice: A cross-sectional study with dentists and validation using structural equation modeling. *PLOS Digit Health*, 3(5): e0000510. <https://doi.org/10.1371/journal.pdig.0000510> [Accessed 20 August 2024]

Washington, V., Franklin, J.B., Huang, E.S., Mega, J.L. & Abernethy, A.P. 2023. Diversity, equity, and inclusion in clinical research: a path toward precision health for everyone. *Clinical Pharmacology & Therapeutics*, 113(3):575-584. <https://doi.org/10.1002/cpt.2804> [Accessed 15 October 2023]

Weeraratna, I.N., Raymond, D. & Luharia, A. 2023. Human-Robot Collaboration for Healthcare: A Narrative Review. *Cureus*, 15(11): e49210. <https://doi:10.7759/cureus.49210> [Accessed 24 June 2024]

Wei, W. & Cao, Y. 2024. Willing, Silent or Forced Participation? Insights from English for Academic Purposes Classrooms. *RELC Journal*, 55(1):63-78. <https://doi.org/10.1177/00336882211066619> [Accessed 15 July 2024]

Westland, J.C. 2022. Information loss and bias in Likert survey responses. *PLoS One*, 17(7): e0271949. <https://doi:10.1371/journal.pone.0271949> [Accessed 17 September 2023]

Wijohn, T.R., Newcombe, R.M., Reynolds, J., El-Jack, S. & Armstrong, G.P. 2024. Informed consent—patients' understanding of risk. *New Zealand Medical Journal*, 137(1590):14-21. <https://doi:10.26635/6965.6303> [Accessed 20 July 2024]

Wilkie, B., Jordan, A., Foulkes, J., Woods, C.T., Davids, K. & Rudd, J. 2023. Examining the validity, reliability and feasibility of capturing children's physical literacy through games-based assessment in physical education. *Frontiers in Sports and Active Living*, 5. <https://doi:10.3389/fspor.2023.1188364> [Accessed 15 September 2023]

William, A., Mirembe, D. & Nabaasa, E. 2024. The Efficiency of a Framework to Enhance Confidentiality and Privacy of Data in Motion. *International Journal of Technology and Management*, 9(1):1-15. <https://utam.ac.ug/ijotm/index.php/ijotm/article/view/90> [Accessed 20 July 2024]

William, F.K.A. 2024. Mastering Validity and Reliability in Academic Research: Meaning and Significance. *International Journal of Research Publications*, 144(1):271-276. <https://doi.org/10.47119/IJRP1001441320246160> [Accessed 20 July 2024]

William, F.K.A. 2024. Interpretivism or Constructivism: Navigating Research Paradigms in Social Science Research. *International Journal of Research Publication*, 143(1). <https://ijrp.org/paper-detail/6086> [Accessed 18 July 2024]

Williamson, S.M. & Prybutok, V. 2024. The Era of Artificial Intelligence Deception: Unraveling the Complexities of False Realities and Emerging Threats of Misinformation. *Information*, 15(6):299. <https://doi.org/10.3390/info15060299> [Accessed 20 July 2024]

Williamson, K.M. & Muckle, J. 2018. Students' Perception of Technology Use in Nursing Education. *Computers, Informatics, Nursing: CIN*, 36(2):70-76. <https://doi.org/10.1097/CIN.0000000000000396> [Accessed 17 October 2021]

Willie, M.M. 2022. Differentiating Between Population and Target Population in Research Studies. *International Journal of Medical Science and Clinical Research Studies*, 2(6):521–523. <https://10.47191/ijmscrs/v2-i6-14> [Accessed 15 September 2023]

Wilson, L., Stuebe, A.M., Pearsall, M., Mansour, M., Tully, K.P., Garvin, J.H., Jones, K. & Patterson, E.S. 2024. Distinguishing Urgent from Non-urgent Communications: A Mixed Methods Study of Communication Technology Use in Perinatal Care. *Journal of Cognitive Engineering and Decision Making*, 0(0). <https://doi.org/10.1177/15553434241251431> [Accessed 18 July 2024]

Wilton, A.R., Sheffield, K., Wilkes, Q., Chesak, S., Pacyna, J., Sharp, R., Croarkin, P.E., Chauhan, M., Dyrbye, L.N., Bobo, W.V. & Athreya, A.P. 2024. The Burnout Prediction on Using Wearable and Artificial Intelligence (BROWNIE) study: a decentralized digital health protocol to predict burnout in registered nurses. *BMC Nursing*, 23(114). <https://doi.org/10.1186/s12912-024-01711-8> [Accessed 24 September 2024]

Witcher, S.D. & Sasso, P.A. 2022. A Comparison of Generational Differences in Faculty Perceptions of Online versus Face-to-Face Professional Development – A Community College Case Study. *College Teaching*, 72(2):140–151. <https://doi.org/10.1080/87567555.2022.2124394> [Accessed 24 September 2024]

Wolbach, E., Hempel, M. & Sharif, H. 2024. Leveraging Virtual Reality for the Visualization of Non-Observable Electrical Circuit Principles in Engineering Education. *Virtual Worlds*, 3(3):303-318. <https://doi.org/10.3390/virtualworlds3030016> [Accessed 14 August 2024]

Wong, I.Y.F., Kwok, T.T.O., Leung, L.Y.L., Lam, Y.H-L. & So, G.L-H. 2024. Immersive Virtual Reality Simulation for Learning Fundamental Nursing Skills: A Mixed-Methods Study. *Nurse Educator*, 00(0):1-6. <https://doi:10.1097/NNE.0000000000001675> [Accessed 20 August 2024]

Wong, B.K.M., Vengusamy, S. & Bastrygina, T. 2024. Chapter 5 - Healthcare digital transformation through the adoption of artificial intelligence, Editor(s): Patricia Ordóñez De Pablos, Xi Zhang, In Information Technologies in Healthcare Industry, Artificial Intelligence, Big Data, Blockchain and 5G for the Digital Transformation of the Healthcare Industry. *Academic Press*, 87-110. <https://doi.org/10.1016/B978-0-443-21598-8.00014-2> [Accessed 24 July 2024]

Wong, P., Brand, G., Dix, S., Choo, D., Foley, P. & Lokmic-Tomkins, Z. 2024. Pre-Registration Nursing Students' Perceptions of Digital Health Technology on the Future of Nursing: A

Qualitative Exploratory Study. *Nurse Educator*, 49(4): E208-E212.
<https://doi.org/10.1097/NNE.0000000000001591> [Accessed 10 July 2024]

Woodcock, S., Sharma, U., Subban, P. & Hitches, E. 2022. Teacher self-efficacy and inclusive education practices: Rethinking teachers' engagement with inclusive practices. *Teaching and Teacher Education*, 117:103802. <https://doi.org/10.1016/j.tate.2022.103802> [Accessed 13 June 2024]

Wosny, M., Strasser, L.M. & Hastings, J. 2024. The Paradoxes of Digital Tools in Hospitals: Qualitative Interview Study. *Journal of Medical Internet Research*, 26: e56095.
<https://doi.org/10.2196/56095> [Accessed 24 September 2024]

Wu, T.T., Lu, Y.C. & Huang, Y.M. 2023. Effect of Multimedia E-Book Use on the Information Literacy of Nursing Students and Health Communication in Student-Led Large- and Small-Group Community Health Education Sessions. *Sustainability*, 15(9):7408.
<https://doi.org/10.3390/su15097408> [Accessed 24 June 2024]

Wu, M., Zhao, K. & Fils-Aime, F. 2022. Response rates of online surveys in published research: A meta-analysis. *Computers in Human Behavior Reports*, 7:100206.
<https://doi.org/10.1016/j.chbr.2022.100206> [Accessed 14 February 2023]

Wynn, M., Garwood-Cross, L., Vasilica, C., Griffiths, M., Heaslip, V. & Phillips, N. 2023. Digitizing nursing: A theoretical and holistic exploration to understand the adoption and use of digital technologies by nurses. *Journal of Advanced Nursing*, 79(10):3737–3747.
<https://doi.org/10.1111/jan.15810> [Accessed 22 June 2024]

Xavier, S. & Nunes, L. 2024. Challenges for Nursing in Future Trends and Developments. *IntechOpen*. <https://doi.org/10.5772/intechopen.112458> [Accessed 20 September 2024]

Xu, A., Baysari, M.T., Stocker, S.L., Leow, L.J., Day, R.O. & Carland, J.E. 2020. Researchers' views on, and experiences with, the requirement to obtain informed consent in research involving human participants: a qualitative study. *BMC Medical Ethics*, 21:93.
<https://doi.org/10.1186/s12910-020-00538-7> [Accessed 28 May 2023]

Xu, M., David, J.M. & Kim, S.H. 2018. The Fourth Industrial Revolution: Opportunities and Challenges. *International Journal of Financial Research*, 9(20):90.
<https://doi.org/10.5430/ijfr.v9n2p90> [Accessed 2 August 2021]

Yadav, S. 2024. Transformative Frontiers: A Comprehensive Review of Emerging Technologies in Modern Healthcare. *Cureus*, 16(3): e56538. <https://doi.org/10.7759/cureus.56538> [Accessed 24 September 2024]

Yan, L., Echeverria, V., Fernandez-Nieto, G., Jin, Y., Swiecki, Z., Zhao, L., Gasevic, D. & Martinez-Maldonado, R. 2024. Human-AI Collaboration in Thematic Analysis using ChatGPT: A User Study and Design Recommendations. 1-7. <https://doi.org/10.1145/3613905.3650732> [Accessed 12 July 2024]

Yelne, S., Chaudhary, M., Dod, K., Sayyad, A. & Sharma, R. 2023. Harnessing the Power of AI: A Comprehensive Review of Its Impact and Challenges in Nursing Science and Healthcare. *Cureus*, 15(11): e49252. <https://doi.org/10.7759/cureus.49252> [Accessed 22 June 2024]

Yoshimi, T., Kato, K., Aimoto, K. & Kondo, I. 2024. Robotic Care Equipment Improves Communication between Care Recipient and Caregiver in a Nursing Home as Revealed by Gaze

Analysis: A Case Study. *International Journal of Environmental Research and Public Health*, 21(3):250. <https://doi.org/10.3390/ijerph21030250> [Accessed 14 August 2024]

Zahid, M.J., Mavani, P., Awuah, W.A., Alabdulrahman, M., Punukollu, R., Kundu, A., Mago, A., Maher, K., Adebuseye, F.T. & Khan, T.N. 2024. Sculpting the future: A narrative review of 3D printing in plastic surgery and prosthetic devices. *Health Science Reports*, 7(6): e2205. <https://doi.org/10.1002/hsr2.2205> [Accessed 24 September 2024]

Zahle, J. 2023. Reactivity and good data in qualitative data collection. *European Journal for Philosophy of Science*, 13:10. <https://doi.org/10.1007/s13194-023-00514-z> [Accessed 1 June 2023]

Zakari, I. & Yar, U. 2019. History of computers and its generations. https://www.researchgate.net/publication/336700345_History_of_computer_and_its_generations/citation/download [Accessed 15 October 2022]

Zakerabasali, S., Ayyoubzadeh, S.M., Baniyasi, T., Yazdani, A. & Abhari, S. 2021. Mobile Health Technology and Healthcare Providers: Systemic Barriers to Adoption. *Healthcare Informatics Research*, 27(4):267-278. <https://doi.org/10.4258/hir.2021.27.4.267> [Accessed 24 July 2024]

Zaman, N., Goldberg, D.M., Kelly, S., Russell, R.S. & Drye, S.L. 2021. The Relationship between Nurses' Training and Perceptions of Electronic Documentation Systems. *Nursing Reports*, 11(1):12-27. <https://doi.org/10.3390/nursrep11010002> [Accessed 13 June 2024]

Zarate, K., Tarconish, E., Mason, E.N., Hardy, J.K. & Ray, A. 2024. Students' Perceptions of Different Grading Systems in Higher Education. *College Teaching*, 1–9. <https://doi.org/10.1080/87567555.2024.2369848> [Accessed 15 July 2024]

Zenani, N.E., Sehularo, L.A., Gause, G. & Chibuike Chukwuere, P. 2023. The contribution of interprofessional education in developing competent undergraduate nursing students: integrative literature review. *BMC Nursing*, 22:315. <https://doi.org/10.1186/s12912-023-01482-8> [Accessed 15 June 2024]

Zhang, B., Luo, J. & Li, J. 2023. Moving beyond Likert and Traditional Forced-Choice Scales: A Comprehensive Investigation of the Graded Forced-Choice Format. *Multivariate Behavioral Research*, 59(3):434–460. <https://doi.org/10.1080/00273171.2023.2235682> [Accessed 20 July 2024]

Zhang, Z. & Ibarra, B. 2024. Mapping the Problem Statement and Study Purposes to the Quantitative Analysis: Insights from Mixed Methods Perspectives. *Journal of Education and Development*, 8(1):11-19. <https://doi.org/10.20849/jed.v8i1.1408> [Accessed 10 July 2024]

Zhang, Y., Pei, H., Zhen, S., Li, Q. & Liang, F. 2023. Chat Generative Pre-Trained Transformer (ChatGPT) usage in healthcare. *Gastroenterology & Endoscopy*, 1(3):139-143. <https://doi.org/10.1016/j.gande.2023.07.002> [Accessed 17 September 2023]

Zhang, K.E. & Aslan, A.B. 2021. AI technologies for education: Recent research & future directions. *Computers and Education: Artificial Intelligence*, 2:100025. <https://doi.org/10.1016/j.caeai.2021.100025> [Accessed 13 June 2024]

Zhenjing, G., Chupradit, S., Ku, K.Y., Nassani, A.A. & Haffar, M. 2022. Impact of Employees' Workplace Environment on Employees' Performance: A Multi-Mediation Model. *Frontiers in*

- Public Health*, 10:890400. <https://doi:10.3389/fpubh.2022.890400> [Accessed 24 September 2024]
- Zhu, X., Rask, M. & Xu, H. 2023. First year nursing students' reflections about developing their verbal nursing skills during their nursing education in China: a qualitative study. *Frontiers in Public Health*, 11:1149512. <https://doi:10.3389/fpubh.2023.1149512> [Accessed 17 September 2023]
- Zickar, M.J. & Keith, M.G. 2023. Innovations in sampling: improving the appropriateness and quality of samples in organizational research. *Annual Review of Organizational Psychology and Organizational Behavior*, 10:315-337. <https://doi.org/10.1146/annurev-orgpsych-120920-052946> [Accessed 16 October 2023]
- Zirar, A., Ali, S.I. & Islam, N. 2023. Worker and workplace Artificial Intelligence (AI) coexistence: Emerging themes and research agenda. *Technovation*, 124:102747. <https://doi.org/10.1016/j.technovation.2023.102747> [Accessed 20 June 2024]
- Ziqubu, S. & Orton, P.M. 2023. "Perspectives of Nurse Educators Towards Technology-Based Education in Selected KwaZulu-Natal Nursing Colleges". *Africa Journal of Nursing and Midwifery*, 25(1):12. <https://doi.org/10.25159/2520-5293/12358> [Accessed 15 September 2023]
- Zlatanova-Pazheva, H. 2024. Generational Marketing: The Different Generations in Bulgaria. *International Multilingual Journal of Science and Technology (IMJST)*, 9(6). <http://www.imjst.org/> [Accessed 24 July 2024]
- Zychlinski, N., Fluss, R., Goldberg, Y., Zubli, D., Barkai, G., Zimlichman, E. & Segal, G. 2024. Tele-medicine-controlled hospital at home is associated with better outcomes than hospital stay. *PLoS ONE*, 19(8): e0309077. <https://doi.org/10.1371/journal.pone.0309077> [Accessed 20 August 2024]

ANNEXURES

ANNEXURE A: INFORMATION SHEET



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RESPONDENTS INFORMATION SHEET

Project Title: Readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town

Dear Respondent

Introduction

My name is Randall Elton Louwson, and I am a registered master's student in Nursing Science at the Cape Peninsula University of Technology. I would like to ask you to offer me an opportunity to explain the research that I wish to undertake, and to ask you to kindly participate in completing a questionnaire. Please note that you are allowed to ask any questions you may have at any time.

Purpose of the research study

In 2020, the healthcare sector was transformed into a new era called Healthcare 4.0. It is also known as the era of smart medicine, an era brought along by the forthcoming 4IR. Nursing students form a fundamental part of the healthcare sector, and in the use of Information Technology (IT) in our healthcare environments.

Therefore, it is of extreme importance that these students should be ready for a technology-mediated healthcare environment in the new era of healthcare. They should acquire basic technology skills such as obtaining competence in both the use of patient care technologies and information management systems.

The objectives of the study are to determine the extent to which senior students are ready to participate in a nursing environment of digital technology in hospitals in Cape Town, as well as to describe the support to be given to nursing students to be ready for a nursing environment of digital technology in hospitals in Cape Town.

Description of study procedures

You, as a respondent, will be asked to complete a questionnaire. The questionnaire consists of 39 items and should not take longer than 30 minutes to complete. The items in the questionnaire will explore your psychological awareness, skills developments, social and interpersonal relationships, and knowledge regarding your readiness as a nursing student to participate in a nursing environment of digital technologies in the hospitals of Cape Town. To protect your confidentiality and anonymity, no identifying details such as your names, surnames or student numbers will be used on the questionnaires, the questionnaires will only be coded. You will complete the questionnaire at your academic institution of training (Bellville campus) or private space in your own time. After the completion of the questionnaire, it will be closed in an envelope and placed in a sealed box, collected by the researcher and sent to a statistician for data analysis. It is only the researcher and statistician that will have access to the responses in the questionnaires.

Risks or discomfort

No actions that might be harmful or cause any discomfort to you as a respondent will be undertaken. In the event of any unforeseen circumstances, the assistance of a lecturer with advanced psychiatric training will be nearby to be consulted.

Benefits to the respondent or others

The benefits of this proposed study for nursing students will be to identify possible gaps in the readiness of students in the education and healthcare settings for the use of technology, that may psychologically affect nursing students to render nursing care in such a technology-mediated environment in the new era of healthcare brought along by the forthcoming 4IR.

Privacy, anonymity and confidentiality

Anonymity will be ensured as no personal information and responses, will be gathered or shared without your knowledge as the respondent. To protect your right to stay *anonymous* no identifying details such as names, surnames or student numbers will be used in the questionnaires. The researcher will make use of coding on the questionnaires. The student will complete the instrument in a private space. The questionnaires will be returned to the researcher in an enclosed envelope placed in a sealed box. It will only be the researcher and the data analyst who will have access to the questionnaires of the respondents, to ensure *confidentiality* of the data. After the data analysis, the questionnaires are stored in a secure

place for five (5) years after which it will be destroyed. The findings from the questionnaires will be published in at least one peer reviewed article and made available to the community of students on request and presented at an educational session to lecturers and nurses from the facilities where students are placed.

Conditions of participation

The participation in this study is entirely voluntary. No pressure will be put on you as a student to take part in this study. The decision to participate is entirely up to you. If you decide to participate in the study and later decide that you want to withdraw, you can do so without the fear of unjust or prejudicial treatment by the researcher. As a respondent, you will be required to sign an informed consent form. This means that the purpose of the study, and ethical principles that will be adhered to, e.g., confidentiality and anonymity, will be explained. The contact details of the researcher will be available to enable you to direct any questions or concerns directly to him.

Expenses

You would not have to pay anything to be a respondent in this study. You will also not be paid to be part of this study. The questionnaire, envelope as well as a black pen will be provided to you.

Contact details

This research study is being conducted by Randall Elton Louwson, a Clinical Educator in Midwifery Nursing Sciences and currently employed at the Cape Peninsula University of Technology (CPUT), Athlone campus.

Please feel free to contact the researcher personally if you have any questions or concerns about the study. The contact details are as follows:

Researcher: Randall Elton Louwson
Telephone number: 0615422598 or 0747344312
E-mail address: louwsonr@cput.ac.za or randylouwson@gmail.com

Should you have any questions regarding this study and your rights as a research respondent, or if you wish to report any problems you have experienced related to the study, please contact:

Supervisor: Professor K. Jooste
Postal Address: Cape Peninsula University of Technology
P O Box 1906, Bellville, 7535
Telephone number: (021) 959 2271
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ANNEXURE B: CONSENT FORM



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WRITTEN INFORMED CONSENT

Letter of request to participate in the study.

Project Title: Readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town

- The purpose, study procedures, risks, benefits, confidentiality, and conditions of participation for this study have been explained to me in a language that I understand.
- I am freely and voluntarily agreeing to participate in the study.
- I understand that if I want to withdraw at any stage, I am free to do so without the fear of unjust or prejudicial treatment by the researcher.
- My questions about the study were answered after reading the information sheet.
- I understand that I can contact the researcher or his supervisor if I have any questions or concerns regarding the study.

Respondent's signature _____

I agree to complete the questionnaire for this study

Witness _____

Date _____

ANNEXURE C: QUESTIONNAIRE



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Topic: The Readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town

Purpose: The purpose of this questionnaire is to explore the readiness of senior nursing students to engage in a new era of healthcare that uses digital technology to render high-quality nursing care in the forthcoming 4IR. Please answer all questions as honestly as possible, as there are no right or wrong answers. **It will take you about 30 minutes to complete the questionnaire.**

Section A: Demographic information

Dear Respondent

All information will be treated as confidential, and the researcher undertakes not to reveal any individual information that appears in this questionnaire.

Please indicate your answer by placing a cross (X) in the box next to the appropriate answer.

1 What is your gender?

Male	
Female	
LGBTQI	

2 What is your age (In complete years)?

--	--

3 What is your home language?

English		Northern Sotho		Tsonga	
Afrikaans		Southern Sotho		Swati	
Xhosa		Venda		Ndebele	
Zulu		Tswana		Other	

4 What is your year of study?

3 rd – Year	
4 th – Year	

5 What is the name of your current nursing programme?

Baccalaureus Technologiae	
Nursing Science Degree (4 years)	
Bachelor of Nursing (4 years)	

6 What is your marital status? *If other, please specify on the dotted lines

Married		Single		Divorced		Other	
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7 Do you work with a computer daily?

Yes		No	
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Section B: Technological readiness

Indicate to what extent you are ready to participate in the forthcoming digital changes, emerging in the new era of healthcare. Place an X below the score you think is appropriate to the item, on your right-hand side of the questionnaire.

The concept “readiness” will be measured in this instrument, referring to your willingness and preparedness for partaking in a digital-orientated nursing environment.

The items will be guided by examples to make the content clearer to answer.

Scale: 1 = Totally unwilling, 2 = Unwilling, 3 = Neutral, 4 = Willing, 5 = Totally willing

<u>Example:</u>	Totally unwilling	Unwilling	Neutral	Willing	Totally Willing	
<i>As a nursing student, I...</i>				4	5	
suggest the use of an iPad to do assignments.		x				
WILLINGNESS						
<i>As a nursing student, I am willing (ready) to participate in the digital changes emerging in healthcare, because...</i>						
	Psychological awareness					
1.	Digital devices become the drive behind how we as individuals, or in groups, will think about the nursing profession.	1	2	3	4	5
2.	Digitalisation in nursing transforms the traditional methods of treatment through digital intelligence e.g., written programs.	1	2	3	4	5
3.	A trend in the field of nursing will occur of less physical involvement with the patient.	1	2	3	4	5
4.	Patients and nurses connect in new ways through a digital-designed nursing process, rather than the traditional hands-on approach.	1	2	3	4	5
5.	Insecurity around the risk of being replaced by robotic nursing care in the future may lead to mental conditions among nursing staff such as depression.	1	2	3	4	5
6.	The use of Information Technology in health care increases nurse's feeling of job satisfaction.	1	2	3	4	5
7.	An environment of higher productivity is brought along by healthcare technology, causing nursing staff to feel useful.	1	2	3	4	5
	Skills development					
8.	Nurses employ new technologies in their daily work life such as electronic duty rosters.	1	2	3	4	5
9.	Different skills will be required to operate digital devices in the workplace.	1	2	3	4	5
10.	The use of mobile application technology e.g., a smartphone, will give nurses speedy access to information, e.g., a reminder to give pain medication to a patient.	1	2	3	4	5
11.	New technologies such as robots providing nursing care will participate more actively in the workplace, such as, e.g., with the distribution of meals to patients.	1	2	3	4	5
12.	After discharge from the hospital, patients will be monitored in their daily activities by a mobile application to ensure their well-being.	1	2	3	4	5
<i>As a nursing student, I am willing (ready) to participate in the digital changes emerging in healthcare, because...</i>						
13.	Nurses demonstrate how to perform an Electrocardiogram (ECG) on a manikin to peers in the workplace.	1	2	3	4	5
14.	Nurses can access basic computer Window programmes such as Microsoft Word, Excel or PowerPoint in preparing a patient presentation to peers.	1	2	3	4	5
		1	2	3	4	5

15.	Nurses make use of electronic health records for patients as it improves patient care through means of accuracy records.					
16.	Nurses can access internet sources to gain more information, e.g., the precautions to give certain medicine to a patient, while working in a healthcare unit.	1	2	3	4	5
17.	Routine nursing tasks, such as the checking of vital signs, are revised to e.g., accommodate more digital orientated devices.	1	2	3	4	5
18.	Nurses are able to use their cellphones to search for information about a patient's diagnosis, to e.g., explore appropriate treatment options.	1	2	3	4	5
Social and interpersonal relationships						
19.	The quality of the relationship between healthcare providers and patients of different cultures improves through digital translation applications, such as Google Translate.	1	2	3	4	5
20.	The use of IT in healthcare allows nurses more time to improve patient care.	1	2	3	4	5
21.	Inter-communication between staff members in healthcare settings is done differently, e.g., an electronic handover of patients by means of Zoom.	1	2	3	4	5
22.	The use of Information Technology (IT) in healthcare improves communication, benefiting patients.	1	2	3	4	5
23.	Telehealth/telemedicine allows patients to consult with doctors over long distances.	1	2	3	4	5
24.	The use of interactive two-way video conferencing in medical consultations lessens the volume of inpatient hospital visits.	1	2	3	4	5
Knowledge						
25.	Information Technology in healthcare is needed to improve high-quality patient care.	1	2	3	4	5
26.	Mobile technologies increase the number of patient admissions, leading to earlier diagnosis and treatment.	1	2	3	4	5
27.	The introduction of the subject Technology in nursing education programmes will benefit nurses to use technology as Professional Nurse.	1	2	3	4	5
28.	The use of IT reduces the paperwork accomplished by nurses.	1	2	3	4	5
29.	The use of smart-bed technology as an in-room monitoring tool provides regular updates on a patient's activities, such as vital signs.	1	2	3	4	5
30.	Patients will be able to make use of medical online software to complete their medical history, which could facilitate more accurate diagnoses.	1	2	3	4	5
31.	The use of cloud storage for patient information helps to improve accessibility while reducing wastage.	1	2	3	4	5
<i>As a nursing student, I am willing (ready) to participate in the digital changes emerging in healthcare, because...</i>						
32.	The use of digital virtual assistants such as Siri (Apple's virtual assistant) will monitor the patients before admission is needed.	1	2	3	4	5
33.	The use of 3D printing is used to create, e.g., prosthetics, or customized dental devices to improve patient care.	1	2	3	4	5
34.	Future nurses require a higher level of education when operating digital devices or machines in healthcare settings, as currently.	1	2	3	4	5
35.	Healthcare training institutions make use of virtual reality technology, such as simulation, to enhance the learning experience of nurses.	1	2	3	4	5
36.	Nursing units making use of digital devices require fewer nursing staff than in the past.	1	2	3	4	5
37.	The movement towards robotic surgery creates an environment of assisting more patients in a shorter period.	1	2	3	4	5
38.	Electronic databases, such as patient records, are protected from cyber-attacks to prevent the compromise of patient confidentiality.	1	2	3	4	5
39.	Radio-frequency identification (RFID) technology will improve patient care by providing information about the patient's vital signs.	1	2	3	4	5

Thank you for your participation ...

ANNEXURE D: LETTER FOR CONSENT FROM HEAD OF DEPARTMENT

PO Box 1906, Bellville, 7535

Tel: +2721-9596911

www.cput.ac.za

E-mail address: louwsonr@cput.ac.za

26 October 2021

To: The Head of Nursing
Cape Peninsula University of Technology
P O Box 1906
Bellville
7535

RE: Request for permission to conduct a research study at the Cape Peninsula University of Technology (CPUT) – Bellville campus

My name is Randall Elton Louwson, and I am a student registered for a master's degree at the Cape Peninsula University of Technology in Bellville.

My study title is **Readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town**. I hereby request to conduct my research study under your guidance and supervision, at the nursing department of the Cape Peninsula University of Technology, Bellville campus.

Data collection will be obtained by:

- A questionnaire that will be completed by filled out by 3rd-and-4th year nursing students at Bellville campus. The researcher will, with the assistance of a lecturer familiar with the study participants, help with the distribution and collection of the complete questionnaires.
- The researcher will schedule a suitable date and time with the Head of Department Campus, and according to the student's year plan, so as not to disrupt the academic program.
- The researcher will ensure that the data collection process will not interfere with the academic responsibilities or requirements of the respondents.
- The researcher will under no circumstances, use any consumables, nor infrastructure of the research site (the university).

- Therefore, the researcher will provide a questionnaire and his own black pens to students who are not in possession of pens, so that no unnecessary financial expenses will be expected of the respondents.
- It should not take longer than 30 minutes for each respondent to complete the questionnaire. The questionnaires will then be collected by the researcher that will be placed in an enclosed envelope.
- The researcher will adhere to the respondent's rights to privacy, confidentiality, and anonymity. No names, surnames or identity numbers will be used on the questionnaire. The researcher will only make use of numbers.
- No actions will be taken that might harm or cause discomfort to the respondents.
- The respondents will receive an information letter in which aspects of the research study will be explained. The information letter contains contact details of the researcher as well as the supervisor. The respondents are free to make contact if they have any questions or concerns before deciding if they want to participate in the research study after which they will sign an informed voluntary consent letter. The respondents will also be made aware of the fact that they can withdraw at any stage without the fear of unjust or prejudicial treatment by the researcher.
- Completed questionnaires are kept under lock and key for at least 5 years, after which they will be destroyed. It will only be the researcher and the data analyst who will have access to the complete questionnaires. The data will be presented as numbers, which will be used in the completion of this study, as well as in the reporting of this study.
- The researcher will make use of cloud-based storage options on either Google Drive or Microsoft OneDrive to store digital research data. The Protection of Personal Information Act 4 of 2013 (POPIA), which came into effect on 1 July 2021, requires that research data comprising personal information must be protected in a secure storage environment. Anti-hacking software will ensure that the data stored is protected and that the confidentiality of study participants remains anonymous.

I am also requesting a classroom at the respective campus, where there is a private space for the respondents to complete the questionnaires. I am attaching the proposal, information sheet as well as the informed consent sheets for your information.

Looking forward to your favorable consideration.

Kind regards,

Randall Elton Louwson



Researchers Signature

Date: January 2022

Researcher: Randall Elton Louwson, Clinical Mentor (Midwifery Nursing Sciences),
CPUT/WCCN, Metro-west campus

Work Address: Western Cape College of Nursing
100 Klipfontein Road
Athlone
7760

Telephone numbers: 0615422598 / 074734312.

Email address: louwsonr@cput.ac.za

Should you have any questions regarding this study and your rights as a research respondent, or if you wish to report any problems you have experienced related to the study, please contact:

Research Supervisor: Prof Karien Jooste

Postal Address: Cape Peninsula University of Technology
P O Box 1906, Bellville, 7535

Telephone number: (021) 959 2271

E-mail address: kjooste1@gmail.com
joosteka@cput.ac.za

This research has been approved by the Research and Ethics Committee of the Faculty of Health and Wellness of CPUT.

ANNEXURE E: LETTER FROM HEAD OF DEPARTMENT TO CONDUCT THE RESEARCH STUDY



PO Box 1906, Bellville, 7535

Tel: +2721-9596911

www.cput.ac.za

8 February 2022

The Office of the HOD: Department of Nursing Science
Cape Peninsula University of Technology
P O Box 1906
Bellville
7535

RE: Request for permission to conduct your research study at the Cape Peninsula University of Technology (CPUT) – Bellville campus

Dear Mr Louwson.

I hereby grant you permission to conduct your research study on the **READINESS OF SENIOR STUDENTS TO PARTICIPATE IN A HEALTHCARE ENVIRONMENT OF DIGITAL TECHNOLOGY IN HOSPITALS IN CAPE TOWN**, at the Department of Nursing Science, Bellville campus.

Please contact the departmental secretary Ms. Vuyokazi Zisile, to arrange a meeting with one of the level coordinators Ms. Chantal Settley to discuss possible dates to access the student population. All the best with your study.

Regards,



HOD: Department of Nursing Science

.....
pp Prof. K Jooste.

ANNEXURE F: ETHICS CLEARANCE CERTIFICATE



HEALTH AND WELLNESS SCIENCES RESEARCH ETHICS COMMITTEE (HWS-REC)

Registration Number NHREC: REC- 230408-014

P.O. Box 1906 • Bellville 7535 South Africa
Symphony Road Bellville 7535
Tel: +27 21 959 6917
Email: sethn@cput.ac.za

22 November 2023

REC Approval Reference No:

CPUT/HWS-REC 2022/H4 (renewal)

Faculty of Health and Wellness Sciences

Dear Mr. Louwson

Re: APPLICATION TO THE CPUT HWS-REC FOR ETHICS CLEARANCE

Approval was granted by the Health and Wellness Sciences-REC to **Mr. RE Louwson** for ethical clearance. This approval is for research activities related to research for **Mr. RE Louwson** at Cape Peninsula University of Technology.

TITLE: Readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town

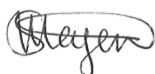
Supervisor: Prof. K Jooste and Dr. P Mudaly

Comment:

Approval will not extend beyond 23 November 2024. An extension should be applied for 6 weeks before this expiry date should data collection and use/analysis of data, information and/or samples for this study continue beyond this date.

The investigator(s) should understand the ethical conditions under which they are authorized to carry out this study and they should be compliant with these conditions. It is required that the investigator(s) complete an **annual progress report** that should be submitted to CPUT HWS-REC in December of that particular year, for the CPUT HWS-REC to be kept informed of the progress and of any problems you may have encountered.

Kind Regards

A handwritten signature in black ink, appearing to read 'S. Meyer', enclosed within an oval shape.

Dr. Samantha Meyer

Chairperson – Research Ethics Committee

Faculty of Health and Wellness Sciences

ANNEXURE G: STATISTICAL ANALYSIS REPORT

30 Kingfisher Walk,
Fairtrees Retirement Village,
Durbanville,
7550

2024-09-02

Certificate of service

This is to certify that I, D.J. van Schalkwyk, performed all the statistical analyses for Mr Randall Louwson's MSc research project.

Regards

A handwritten signature in dark ink, appearing to be 'D.J. van Schalkwyk', written on a light-colored, slightly textured background.

Dirk Jacobus van Schalkwyk
Emeritus Professor in Statistics
PhD University of London

ANNEXURE H: EDITING LETTER



FRANCI CRONJE

(PhD, Media Studies)

Author's Development Editor

Cell: 0825573647

Email: franci.cronje@gmail.com

Banking details:

DR FRANCI CRONJE

FNB Cheque Account 51060087596

Century City

Branch code: 209809

Date: 29 November 2024

To whom it may concern:

I hereby confirm that I have edited the dissertation:

Readiness of senior students to participate in a nursing environment of digital technology in hospitals in Cape Town

The author, Randall Elton Louwson, ultimately decided whether to accept or decline any recommendations made by the editor, and it always remains the author's responsibility to confirm the accuracy and originality of the completed work.

Signed:

Dr Franci Cronje

PhD (Media Studies); MA(FA); MPhil in Higher Education

Email: franci.cronje@gmail.com

ANNEXURE I: LINK TO PLAGIARISM REPORT

Mr

by Randall Elton Louwson

Submission date: 12-May-2025 08:21AM (UTC+0200)

Submission ID: 2673595098

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"Development and Investment in
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Year Reflection", CRC Press, 2024
Publication

14 "Design for Tomorrow—Volume 2", Springer
Science and Business Media LLC, 2021
Publication

15 R. Dahman. "AMSM- Sampling Distribution-
Chapter Three", Open Science Framework,
2018
Publication

16 Kai Huter, Tobias Krick, Dominik Domhoff,
Kathrin Seibert, Karin Wolf-Ostermann, Heinz
Rothgang. "
Effectiveness of Digital Technologies to
Support Nursing Care: Results of a Scoping
Review
", Journal of Multidisciplinary Healthcare, 2020
Publication

17 Moustaq Karim Khan Rony, Khadiza Akter,
Mitun Debnath, Md Moshir Rahman et al.
"Strengths, Weaknesses, Opportunities and
Threats (SWOT) Analysis of Artificial
Intelligence Adoption in Nursing Care",
Journal of Medicine, Surgery, and Public
Health, 2024
Publication

- 18 Tatsuya Yoshimi, Kenji Kato, Keita Aimoto, Izumi Kondo. "Robotic Care Equipment Improves Communication between Care Recipient and Caregiver in a Nursing Home as Revealed by Gaze Analysis: A Case Study", International Journal of Environmental Research and Public Health, 2024
Publication
-
- 19 Stephanie M. Noble, Martin Mende, Dhruv Grewal, A. Parasuraman. "The Fifth Industrial Revolution: How harmonious human-machine collaboration is triggering a retail and service [r]evolution", Journal of Retailing, 2022
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-
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- 30 Moeketsi, Senkgobeng Maria. "The Experiences of Learners in Large Classes Regarding the Use of Virtual Technology at a Nursing College", University of Johannesburg (South Africa), 2021

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-
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Publication

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Publication

-
- 33 Callaghan, Natasha Chomba. "South African Academics' Intent to Quit and Intent to Emigrate: An Integration of Turnover and Emigration Theories", University of the Witwatersrand, Johannesburg (South Africa), 2025

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-
- 34 Georgina Neve, Molly Fyfe, Benedict Hayhoe, Sonia Kumar. "Digital health in primary care: risks and recommendations", British Journal of General Practice, 2020

Publication

-
- 35 Natalia Fischer-Suárez, David Lozano-Paniagua, Jessica García-González, Gracia

Castro-Luna et al. "Use of Digital Technology as a Collaborative Tool among Nursing Students—Survey Study and Validation", International Journal of Environmental Research and Public Health, 2022

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-
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