



**Gamification as a pedagogical tool to promote environmental sustainability in a university of technology**

by

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## DECLARATION

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Signed

A handwritten signature in black ink, appearing to read 'Kwame Opoku-Asare', with a stylized flourish at the end.

Date: 5<sup>th</sup> September 2022

## **ABSTRACT**

Gamification has emerged as an interesting tool for learning. The concept has been tested in different real-world environments where feedback from available cases has proven to be very successful. Gamification has been used to gamify learning experiences in fields such as business, information technology and education. This study was conducted to explore the use of gamification as a pedagogical tool to enhance graphic design students' engagement with environmental sustainability that could support related behaviour adaptation and change. The study was conducted through design-led approaches in a higher education institution of technology in Ghana. The participants in the study consisted of 165 undergraduate graphic design students whose gamified learning experiences revolved around environmental sustainability and climate change in the context of design education in Ghana. The study was situated within the constructivist research paradigm and therefore, the gamified learning experiences of the participants informed the outcome of the research. The study was conducted using the Octalysis model as a lens to inform the design of the gaming experience and analyse the outcome of the research. This study makes a contribution to the knowledge of climate change and environmental sustainability and the theory and application of gamification. A framework that could guide the integration of gamification into design education within African universities is proposed.

## **KEYWORDS**

Behavioural Change, Climate Change, Environmental Sustainability, Gamification, Participatory Design, Human-Centred Design, Graphic Design, Design Education, Higher Education, Africa.

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## **DEDICATION**

I dedicate my thesis, with a special feeling of gratitude, to my loving parents, Mr and Prof. (Mrs) Opoku-Asare, whose words of encouragement and push for tenacity keeps ringing in my ears; my wife Victoria for standing closely by me; Dr Ralitsa Diana Debrah for gently urging me on with late night encouragement calls and discussions; and all my special family and friends.

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## ABBREVIATIONS AND ACRONYMS

HEI	Higher Education Institution
MDA	Motivational-Development Assessment
SDGs	Sustainable Development Goals
SDT	Self-Determination Theory
UDL	Universal Design for Learning

## GLOSSARY

Climate change	is a term used to describe a long-term shift in global and regional climate patterns which is evidenced in the statistics of the weather, including their averages. This change has been apparent starting from the mid to the late 20 <sup>th</sup> century and forward. These climatic changes are attributed to increased levels of atmospheric carbon dioxide produced by fossil fuels. Other manmade activities are also attributed to these harsh climatic conditions and its horrendous impact is being felt globally (National Oceanic and Atmospheric Administration on Weather Service, 2007:1–2).
Design thinking	builds on designerly ways of thinking that extends beyond planning to produce artefacts and services. The process usually follows the way designers conceptualise ideas such as sketching, prototyping and storytelling to arrive at innovative solutions. The approach of developing innovative solutions is not only limited to designers but can be accessed by other people to explore innovative solutions through design processes



(Brown & Rowe, 2008:1–2; Johansson-sköldberg *et al.*, 2013:121–124; Liedtka, 2015:925–926).

Gamification	is the process of using game mechanics such as reward systems, points and game thinking in non-gaming contexts to motivate and engage users and solve problems (Deterding <i>et al.</i> , 2011:2; Kiryakova <i>et al.</i> , 2013:1).
Game-based learning	is one experiential learning approach that facilitates interaction, collaboration, peer learning, active learning and simultaneously keeps students motivated in learning situations (Deif, <b>2017:359</b> ).
Pedagogy tool	is anything a person uses to learn or teach. Some pedagogy tools such as textbooks are considered traditional. In the 21st century, the needs of learners and educators have changed and for this reason, more tools for pedagogy are emerging. Technology has played a major role in this advancement, with students and teachers now using tools such as websites or mobile device applications as part of pedagogy ( <a href="http://www.wisegeek.com">http://www.wisegeek.com</a> , 2017: paras 1-2).
Sustainability	is a concept that encompasses environmental, economic and societal issues. In essence, the term is used to describe conservation, deployment and reuse of resources in responsible ways (Malhotra <i>et al.</i> , 2013:1265). Furthermore, it is an all-inclusive concept describing responsible behaviour by individuals and business entities to ensure that their actions do not destroy the systems that support them but rather keep the system intact and functioning for future generations to meet their own needs (Jones <i>et al.</i> , 2016:38–39).

# 1 CHAPTER ONE: INTRODUCTION

This introductory part of the thesis outlines the phenomena that were investigated, the methodological approach and the analytical framework that was used to achieve the stipulated objectives of the research.

## 1.1 Background to the study

Games are played in every human culture across the globe, especially by children (Lahri, 2015; Seaborn & Fels, 2015:14). This includes traditional games that combine incentives, points, competition, and feedback loops (Pho & Dinscore, 2015:1). Players willingly invest time and energy playing games mainly because they find the fun gained from playing games rewarding (Kapp *et al.*, 2020:2264). Game mechanics, such as reward systems, points and game thinking can be found in many non-gaming contexts and are usually aimed at engaging specific users for solving problems and other purposes (Gündüz & Akkoyunlu, 2020:2; Conaway & Garay, 2014:2; Zichermann & Cunningham, 2011:16). Games can sometimes be perceived as subtle and at other times as obvious in human activities. Such games can range from fitness applications on mobile devices that are engineered to keep users going to the local supermarket that offers prizes to customers for buying from their stores, to games in airline businesses (Conaway & Garay, 2014:1–2; Zichermann & Cunningham, 2011:29–32) where customers' preferred airlines use games to reward their clients with customer loyalty rewards such as “frequent flyer miles”.

Game-based learning implies using game mechanics like reward systems in non-gaming settings to engage learners and solve problems (Zichermann & Cunningham, 2011:16; Lucassen & Jansen, 2014:194–195). This involves the use of game mechanics or the fun elements of games, such as points, leaderboards, levels and game thinking to engage specific users in solving problems and for other purposes (Gündüz & Akkoyunlu, 2020:2; Conaway & Garay, 2014:2). The belief that game-based learning or gamification can shape users' behaviour in desirable ways is driving increased adoption of gamification in marketing and corporate organisations (Wünderlich *et al.*, 2020:273; Sandusky, 2016:75; Škuta & Kostolányová, 2016:423). Hence, *gamification* simply defines using the fun elements of games in education to engage users and keep them entertained while adding to their knowledge (Pho & Dinscore, 2015:1–2). Thus, game-based learning enhances and increases knowledge by creating a balance between game design, loyalty programme design and behavioural economics.

*Gamification* includes incentives that many mobile subscribers use without recognising that they are functioning in a gaming scheme (Dias, 2017:98; Hamari *et al.*, 2014:3025–3026; Conaway & Garay, 2014:1-2). Gamification is a relatively recent concept and an approach to motivating the user to act (Byrne, Ito & Furuyabu, 2022:56). Its potential for educational purposes has not been fully explored in many parts of Africa. Hence, I explored gamification in this study as an instructional tool in the sense in which video games for example, are adapted to enhance instruction and knowledge building, in design education. Essentially, this game-based learning approach (Subhash & Cudney, 2018:192; Plass *et al.*, 2015; Houtari & Hamari, 2012; Deterding *et al.*, 2011) was aimed at conveying concepts of environmental sustainability and climate change that could support related behavioural change within the context of design education.

## **1.2 Research problem**

This section initially provides a comprehensive background to various aspects associated with gamification. This outline defines gamification concepts and setting boundaries for the research topic. Finally, the section closes with a succinct presentation of the problem.

Since the inception of industrialisation, human activities like bush burning, mining and industrial production continue to release large volumes of greenhouse gases such as carbon dioxide (CO<sub>2</sub>) to pollute the earth's atmosphere (Amekudzi *et al.*, 2017:9; Müller-Kuckelberg, 2012:2; IPCC, 2014:42). This has led to an overwhelming global warming effect on the climate and resulting in extreme weather events such as droughts and flooding (Amekudzi *et al.*, 2017:6; Asante & Amuakwa-Mensah, 2015:6; Kim *et al.*, 2013:428; MoE Moldova, 2011:16). Climate change and the need to sustain the earth's natural environment have become top priorities in the global discourse because of the widespread implications of climate change risks on all aspects of life on the Earth (Vardoulakis *et al.*, 2015:299–300; Whitmee *et al.*, 2015:1973-1974; Boon, 2016:1009). However, climate change is often an abstract concept and difficult to communicate in appropriate messages that people can understand (Malhotra *et al.*, 2013:1265; Moser & Dilling, 2004:34). In attempting to address this problem, gamification was explored as an instructional tool in an HEI of technology in Ghana. The understanding is that gamification “is one communication and educational approach that can be used to increase both literacy and engagement” with climate change (Rajanen & Rajanen, 2019:254) towards promoting pro-environmental attitudes and behaviour among the young design students (Ro *et al.*, 2017:21). Hence, game-based learning

was investigated as a means to connect the demands and needs of climate change to design education to promote a sustainable future.

Gamification or *gameful learning* is a fairly recent development in mediated communication and public culture that seeks to promote and support users to interact productively within an environment, on an issue or a process (Dicheva *et al.*, 2015:75–76; Trybus, n.d.: para.8). It employs the use of computers and game mechanics to engage players (Eseryel *et al.*, 2016:42–43). Engaging student designers to explore alternative ways to address challenges relating to environmental sustainability is in itself difficult because “we cannot force people to change and should not spoon-feed young generations with information about what is the right (or wrong) thing to do” (Chung *et al.*, 2013:3). However, since most students in the 21st century are familiar with and like games (Pho & Dinscore, 2015:5; Kim, 2013:3; Johnson *et al.*, 2014), gamification or *game-based learning* was considered an appropriate tool to mediate the design students’ learning on climate change and environmental sustainability.

In recent times, one approach that is being used to induce particular actions and increasing learner commitment to learning is gamification (Lucassen & Jansen, 2014:195). Like video games, gamification and game elements are being used to persuade users to develop desirable behaviours and adopt values as *players* (Deterding *et al.*, 2011:2). Thus, gamification implies “taking the ‘building blocks’ of games and implementing them in real-world situations, often with the aim of inducing specific behaviours within the gamified situation” (Sailer *et al.*, 2017:371). In this research case, this was done to advocate environmental sustainability thinking towards sustainable design practice within the graphic design curriculum in the selected HEI in Ghana.

Gamification can easily be employed to solve problems, motivate players and inspire behavioural change (Hamari, Koivisto & Sarsah, 2014:3026). In the last few years, there has been a surge of interest in *green gamification*, which is beginning to affect almost every aspect of human living (Pho & Dinscore, 2015:1). *Green gamification* concepts are applied to services such as cars where service providers rank and reward the fuel-efficient driving performance of their clients (Kim, 2015:12). Another scenario where *green gamification* is applied is waste management where home recycling behaviour is monitored and rewarded. An example of such a gaming system is the “Recyclebank” (Froehlich, 2015:2). The GreenBiz Group report of 2012 also points to businesses increasingly using game mechanics as “rewards for making good, green choices” (Conaway & Garay, 2014; Joel, 2013:9).

Furthermore, based on the power and flexible nature of gamification as a persuasive tool (Al-Azawi *et al.*, 2016:132), it was anticipated that it would be a useful educational tool for advocacy on environmental sustainability, which could motivate people to adopt sustainable ways of living. An important objective is to enlighten the current and next generations about climate change and its impacts as a way of encouraging them to take care of the environment and sustain it (Manzano-León *et al.*, 2021:3; Rajanen & Rajanen, 2019:254; Mishra *et al.*, 2015:122).

In agreement with the views of Chung *et al.* (2013:2), who point out that extending education on the environment to young people is critical to environmental sustainability and life on Earth, this study extended the concept of environmental sustainability to graphic design students at an HEI of technology in Ghana, using green gamification as a way of promoting environmental sustainability.

Human activities since the start of industrialisation in 1760, continue to deplete the earth's natural resources and their adverse effects on the environment are felt everywhere (Amekudzi *et al.*, 2017:9; Riedy, 2016; Gustafsson & Ijla, 2016:459; Mishra *et al.*, 2015:109–111). Global warming-induced climate change is manifesting in the form of increased droughts, floods, and natural disasters (Illtus, 2015:3). Climate change has indeed become a global problem due to its threat to the earth and its ecosystem (Reckien *et al.*, 2017:159; Hu & Chen, 2016:1; Vardoulakis *et al.*, 2015:299–300; Kim *et al.*, 2013:428). Climate change is also a multifaceted social and scientific matter the world does not fully understand or know how to tackle its risks and vulnerabilities (Stevenson *et al.*, 2017:1; Krasny & DuBois, 2016). The IPCC is concerned that humanity is in an “unprecedented period of change” (IPCC, 2014:11; 2018). In a developing economy context such as Ghana, climate change and environmental sustainability have not been fully promoted in the educational system and to the public at large, nor have they been an integral part of design education in higher education institutions (HEIs), secondary or primary schools (Boakye, 2015:5-7; Boateng & Boateng, 2015:7). However, it is a common phenomenon to see students playing games on daily basis, which are most often designed with graphic design elements.

Graphic designers retain a variety of tools such as typography, images, colour, drawing and space (Motley, 2017:231) that could be explored to convey ideas and information to promote environmental sustainability in gamified contexts. Similar to Chung, To and Li's (2013) study on gamification of environmental impacts in digital media, this study adopted gamification as a pedagogical tool to promote environmental sustainability as part of graphic design education in a higher education institution of technology in Ghana. With very little known of gamification in HEIs

offering design education in Ghana, this study was designed to advocate behavioural change regarding environmental sustainability as part of graphic design education. The aim was to enhance graphic design students' engagement with climate change and environmental sustainability to support related behaviour adaptation and change.

An interesting finding is “gamification can bring climate change communication to a new level by harnessing the individuals' abilities and interests through well-designed technological affordances” (Rajanen & Rajanen, 2019: 254). The visual-based methods that graphic design offers provided the researcher the opportunity to use the design process and “designerly ways of knowing, thinking and acting” (Cross, 2001:33) to develop gamified learning experiences to introduce climate change and sustainability thinking to enable the young graphic designers to interrogate local environmental challenges and design sustainable solutions that communicate relevant sustainability messages in simple terms that would be understood in Ghana.

Having comprehensively outlined gamification concepts, the preceding paragraphs constitute an explanatory backdrop for the research topic. Section 1.2 closes with the presentation of the research problem. Although much has been published concerning gamification itself, there remains a paucity of published literature addressing gamification as a pedagogical tool to promote awareness of climate change and environmental sustainability in a university of technology. The identified problem leads to the resultant aim of the study (Section 1.3), its research questions (Section 1.4) and objectives (Section 1.5).

### **1.3 Research aim**

The study aimed to explore gamification as a pedagogical tool to enhance graphic design students' engagement with climate change and environmental sustainability that could support the related behaviour adaptation and change within the context of an HEI of technology in Ghana.

### **1.4 Research questions**

This section sets out the research questions linked to the aim of the study. The research questions comprised one major question (MRQ) mapped to two sub-questions (SQ1 and SQ2).

**MRQ:** How might gamification be integrated into design pedagogy to enhance graphic design students' engagement with environmental sustainability within the context of an HEI in Ghana?

**SQ1:** What design-related game mechanics could be employed to enhance graphic design students' engagement with environmental sustainability praxis within the context of an HEI in Ghana?

**SQ2:** How does gamification as an instructional tool enhance the understanding of the abstract notion of environmental sustainability within the context of design education?

## **1.5 Objectives of the research**

The aim of the study is associated with two research objectives: RO1 and RO2. RO1 links to SQ1 whilst RO2 relates to SQ2 as follows:

**RO1:** To identify the categories of gamified tools (applications/methods) that would be suitable for instruction to support graphic design students' engagement with environmental sustainability.

**RO2:** To explore the development of a gamification framework that could guide the teaching of environmental sustainability practices within a graphic design course in an HEI in Ghana.

## **1.6 Game-design mechanics**

Gamified learning implies “application of game dynamics, mechanics and frameworks in non-gaming settings” (Lucassen & Jansen, 2014:195). It focuses on user engagement and problem solving through a change in behaviours (Bicen & Kocakoyun, 2018:75; Hamari, Koivisto & Sarsah, 2014:3026). A common structure or model for game design is Mechanics, Dynamics and Aesthetics (MDA). MDA basically involves analysis of game elements (Zichermann & Cunningham, 2011:35-36). Mechanics make up the functional components and Dynamics are interactions the player has with these mechanics. Aesthetics go beyond the look and feel of the game to how they make the player feel as they engage with it. Aesthetics are also seen by others as the result of Mechanics and Dynamics working together within a gaming system.

Attempts by several educators to effectively utilise game dynamics to enhance learner enthusiasm and attainment have achieved different results (De Gloria *et al.*, 2012:5; Stott & Neustaedter, 2013:1). With its increasing number of applications in diverse areas of day-to-day life, gamification as a tool for education is becoming more and more viable (Trybus n.d., paras 2–16). Gamification offers a means for the potential of games to be applied in teaching and learning as well as change

learner behaviour in desirable ways (Škuta & Kostolányová, 2016:423; Bíró, 2014:150). The underlying factor is that learning and play are interconnected (Korn *et al.*, 2017:31; Eseryel *et al.*, 2014) since “you cannot play a game if you cannot learn it” (Gee, 2007:3 as cited in Deif, 2017:359). In this respect, gamification actually makes learning a game (Al-Azawi *et al.*, 2016). This probably explains the proposal to consider gamification as the fifth learning theory after the behaviourist, cognitivist, constructivist and connectivism learning theories (Škuta & Kostolányová, 2016:428).

In recent years, gamification tools have been applied in fields such as architecture education, the teaching of history, language, healthcare, human resource management, business, environmental protection and logistics, amongst others (Manzano-León *et al.*, 2021:1; Ofosu-Ampong, 2020:115; Wüncherlich *et al.*, 2020:273; Dichev & Dicheva, 2017:1). Gamification is also being used to re-engineer conventional teaching and learning with a special view to the characteristics of the learners, their routes of learning and the reward system, whether the plan is to change the learning content or not (Al-Azawi *et al.*, 2016; Bíró, 2014:150). Despite this, application of gamification tools in design pedagogies has not been fully explored. This is what this study sought to do.

### **1.7 Outcomes, results and contributions of the research**

The outcomes of this research include guidelines that could inform the design and development of visually-based gaming tools for environmental sustainability. Furthermore, a framework for gamifying learning experiences in an HEI was developed, and guidelines for integrating game-based learning as part of design education to advocate environmental sustainability that could influence behavioural change have been formulated. The framework and related guidelines are applicable to all HEI courses.

### **1.8 Games, gamification and education**

Games are a part of human existence and are used in different cultures. They are characterised by rules, feedback systems and goals, involve voluntary participation, surprise, challenge, failure and are primarily for the purposes of enjoyment (Arnab *et al.*, 2015:404–405; Buckley & Doyle, 2014). On the other hand, gamification as a relative neologism has been used in different situations to mean the introduction of games or gaming elements, such as what makes it enjoyable, into other areas of life (Martí-Parreño *et al.*, 2016:663–665). Cases of effective gamification application in education have mainly focused on extracting the underlying principles



of games and reconfiguring the educational experience to build on those principles (Oxford Analytica Ltd, 2016:4).

## **1.9 Significance of the research**

The aim of this study was to inform design educators about added foundational blocks and tools such as game mechanics they could adapt to enrich their lessons and enhance their students' engagement with environmental sustainability. This was specifically done with a view to conveying concepts of environmental sustainability and climate change to a younger generation of graphic designers through educational gamification as a sustainability strategy.

## **1.10 Conceptual model for interaction**

Yu-kai Chou's (2012) Octalysis framework was selected as the conceptual model for this study. The Octalysis framework elaborates on what drives those who play games and the drivers that enable the games to engage the user. Gamification is a human-focused design method with significant implications for the role of emotional elements in the design of gamified experiences. Yu-kai Chou's concept of gamification was deemed an appropriate tool for achieving the objectives of this study.

## **1.11 Outline of thesis**

**Chapter One** is the introduction of the thesis. Here the research problem is captured with the study objectives and main aim of the research being detailed.

**Chapter Two** covers the literature review on climate change, environmental sustainability, gamification, current research on gamification and gamification in the field of education.

**Chapter Three** focuses on the research methodology. It includes an account of the research design, the data collection processes followed, the Octalysis gamification conceptual model adopted for the study, and the procedures that were employed to design and deploy the gamified workshop activities in the research.

**Chapter Four** captures the findings obtained from the data gathered from the study participants on climate change and environmental sustainability and the gamified learning activities.

**Chapter Five** analyses the findings documented in Chapter Four. The chapter reviewed various topics including question and answer session experiences, design projects, survey results,

interest in climate change, and designers' contribution to climate change and environmental sustainability.

**Chapter Six** provides the summary, conclusion and recommendations of the study. The research contributions (practical, theoretical, methodological) and implications for further research are indicated here.

## 1.12 Chapter summary

Gamification has emerged as an interesting way of learning. It is a fairly novel 21<sup>st</sup> century strategy for inducing performance among users (Bicen & Kocakoyun, 2018:75). The concept has been tested in different real-world environments where feedback from available cases has proven to be very successful. Gamified learning experiences are being used in the fields of information technology, commerce, training, among others (Ofosu-Ampong, 2020:115; Manzano-León *et al.*, 2021:1). This study explored gamified learning as a pedagogical tool to enhance selected third-year undergraduate graphic design students' engagement with environmental sustainability that could support related behaviour adaptation and change". This study was conducted through design-led approaches in the premier HEI of technology in Ghana. The participants were mainly higher education undergraduate graphic design students whose learning experiences on climate change and environmental sustainability were gamified in the context of Ghana.

The study was situated within the constructivist research paradigm, which views knowledge and meaning as co-constructed (Creswell & Creswell, 2018; Wahyuni, 2012:69–70; Thomas, 2010:301). Therefore, the gamified learning experiences of the design students informed the research findings. The Octalysis model was used as a lens to inform the design of the gaming experience and to analyse the outcome of the research. This study contributes to knowledge of environmental sustainability and climate change as well as the theory and application of gamification. It proposes a framework that could guide the integration of gamification into design education within African universities.

## 2 CHAPTER TWO: LITERATURE REVIEW

This section of the thesis presents an overview of literature that was consulted on climate, climate change, sustainability, design thinking, environmental sustainability, games, gamification and gamified learning in education. This literature review is presented from four perspectives, namely:

- Climate and climate change,
- Environmental sustainability,
- Design as a discipline, and
- Graphic design and sustainability.

### 2.1 Climate and climate change

The Intergovernmental Panel on Climate Change (IPCC, 2014:11) attests to the fact that the earth's climate has warmed drastically over the last century. Referred to as *global warming*, the unprecedented warming of the earth's climate is generally manifesting as flooding, drought and other extreme weather events and natural disasters (Iltus, 2015:3). Changing climate conditions due to global warming is recognised as a threat to the earth and its entire ecosystem (Mishra *et al.*, 2015:109–111; Asante & Amuakwa-Mensah, 2014:6; Kim *et al.*, 2013:428; Vardoulakis *et al.*, 2015:299–300). The clarion call now is for people and governments to take steps to halt climate change to save our environment and life on Earth (Nicholls, 2016).

#### 2.1.1 Climate

Climate describes the average daily atmospheric conditions that persist in a specific location over time. It is the accumulation of heat, moisture and energy in the atmosphere and their circulation within the atmosphere (Amekudzi, Preko, Yamba, Wemegah, Aryee, Osei & Agyekum, 2017:2). *Climate* is also conceptualised as “the expected weather variations in a particular place over a period, and is calculated statistically in terms of mean temperatures, duration of rainy seasons and incidence of droughts” (National Research Council (NRC), 2012:1). The term *climate* also describes “the average of different weather conditions at a certain point on planet Earth. Typically, *climate* is expressed in terms of expected temperature, rainfall and wind conditions based on historical observations” (Sissakian, Jassim, Adamo & Al-Ansary, 2022:13). Moreover, the term implies “the long-term weather patterns that describe a region” (Adedeji *et al.*, 2014:115) and “the

average weather of temperature, humidity, precipitation, cloudiness and wind that we experience in the atmosphere at a given time in a specific location” (Climate Change 101: climate science basics, 2016:1). Hence, climate simply describes the typical weather conditions over a specific location over a long time.

Change forms part of the earth’s unpredictability with respect to the interface between the geology of the planet, the atmosphere, the oceans and solar radiation (The National Oceanic and Atmospheric Administration Weather Services (NOAAWS), 2007:2). Consequently, climate naturally changes over decades, centuries and millennia (Amekudzi *et al.*, 2017:5; Adedeji *et al.*, 2014:117). Geological records also confirm that the earth has suffered massive climatic changes in times past (Amekudzi *et al.*, 2017:5). Moreover, global climatic change has been observed since the mid to the late 20<sup>th</sup> century due to rising global temperatures caused by human activities (NRC, 2012:8). Thus, climate change describes a critical environmental variable that has overwhelmed the earth and its ecosystem (Asante & Amuakwa-Mensah, 2015:6; Müller-Kuckelberg, 2012:46; NOAAWS, 2007; Amekudzi *et al.*, 2017:6).

### **2.1.2 Climate change**

The term *climate change* refers to “a change in either the average climate or climate variability that persists over an extended period” (Riedy, 2016) and “a systematic change in the long-term state of the atmosphere over multiple decades or longer (Climate Change 101: climate science basics, 2016:1). The concept defines the “shift in normal climate statistics that have been compiled in a given location over a period of a year and between a decade and the next” (Amekudzi, 2017:5). It also refers to the “cumulative variations in climate statistics in a particular region over the course of years, decades, or centuries” (NRC, 2012:1). Climate change is a multifaceted social and scientific phenomenon that the world neither fully understands nor knows how to tackle its risks and vulnerabilities (Stevenson *et al.*, 2017:1; Krasny & DuBois, 2016). The IPCC’s heightened concern that humanity is in an “unprecedented period of change” (Gebreyes *et al.*, 2017:829) underscores the urgency of actions needed to handle the risks of climate change, which the global community of scientists blame on global warming induced by human activities like modern farming, oil drilling and mining (Nicholls, 2016; Gustafsson & Ijla, 2016:459; Whitmee *et al.*, 2015:1973–1974). Climate change has thus become a huge threat to the natural environment and human societies (Reckien *et al.*, 2017:159; Hu & Chen, 2016:1; Ojala, 2012:625).

### 2.1.3 The human factor in climate change

Since human societies started industrialisation and production of machine-made goods in 1760, large quantities of carbon dioxide and several heat trapping greenhouse gases (GHGs) and polluting emissions have been released into the earth's atmosphere. The sources of such emissions include the use of coal, oil, pesticides and other agricultural chemicals (Riedy, 2016; Mishra *et al.*, 2015:109–111; Müller-Kuckelberg, 2012:2). The combined amounts of GHGs in the earth's atmosphere have increased to levels that exceed what plants and the oceans, that serve as carbon sinks, can sequester (Amekudzi *et al.*, 2017:9). The net result is a 4 °C rise in the earth's surface temperatures over 100 years (NRC, 2012:8) that has led to the phenomenon named climate change, mainly due to excessive global consumption of fossil energy (IPCC, 2014:11; Gebreyes *et al.*, 2017:829-830).

In effect, it is the excess GHGs in the atmosphere that has caused what is known today as climate change, the critical environmental variable that has overwhelmed the earth and its ecosystem (Amekudzi *et al.*, 2017:6; Asante & Amuakwa-Mensah, 2015:6; Müller-Kuckelberg, 2012:46; NOAAWS, 2007). Global warming can thus be linked to the high per-capita gross domestic product (GDP) achieved by large economies that used coal and other fossil fuels to drive industrialisation in the past. It can also be reasonably concluded that industrialised nations achieved economic growth at the expense of increased GHG emissions (Nicholls, 2016).

Global warming and climate change pose a serious threat to life on Earth in terms of the frequency of heat waves, floods, rainfall-triggered landslides and sea level rise that are occurring in recent times. Forests are also gradually turning into arid areas, natural habitats of wildlife are getting degraded, the earth's natural cover and the biodiversity that sustains water resources, food production, and human livelihood on Earth is getting depleted very fast (Reckien *et al.*, 2017:159; Hu & Chen, 2016:1; Riedy, 2016; Ojala, 2012:625). It is even feared that the adverse climate change consequences on the environment over time can generate conflict over water and other natural resources in parts of the world (Connolly-Boutin & Smit, 2016:389). The clarion call now is for the world to adopt practical measures, such as education, to abate the looming climate change toll as a means of saving the natural environment which supports the world we live in (Gustafsson & Ijla, 2016:459; Whitmee *et al.*, 2015:1973-1974).

The fact that climate change has direct consequences for all human beings and life on Earth makes it imperative for people to be made aware of its adverse effects to encourage their

preparedness to mitigate them (Boon, 2016:1009). It is important that the world acts swiftly to save the earth from climate change risks to sustain humanity and the flora and fauna the planet supports (Vardoulakis, 2015:299–300). Unfortunately, the idea that human efforts can halt the effects of changing climate to save the natural environment and life on Earth does not correspond with public concern over the looming environmental disaster (Nicholls, 2016; Taylor, 2012). For example, Figure 2.1 depicts a UK study on the threat of climate change risks that revealed a 26 per cent decline in public interest in the phenomenon between 2000 and 2010.

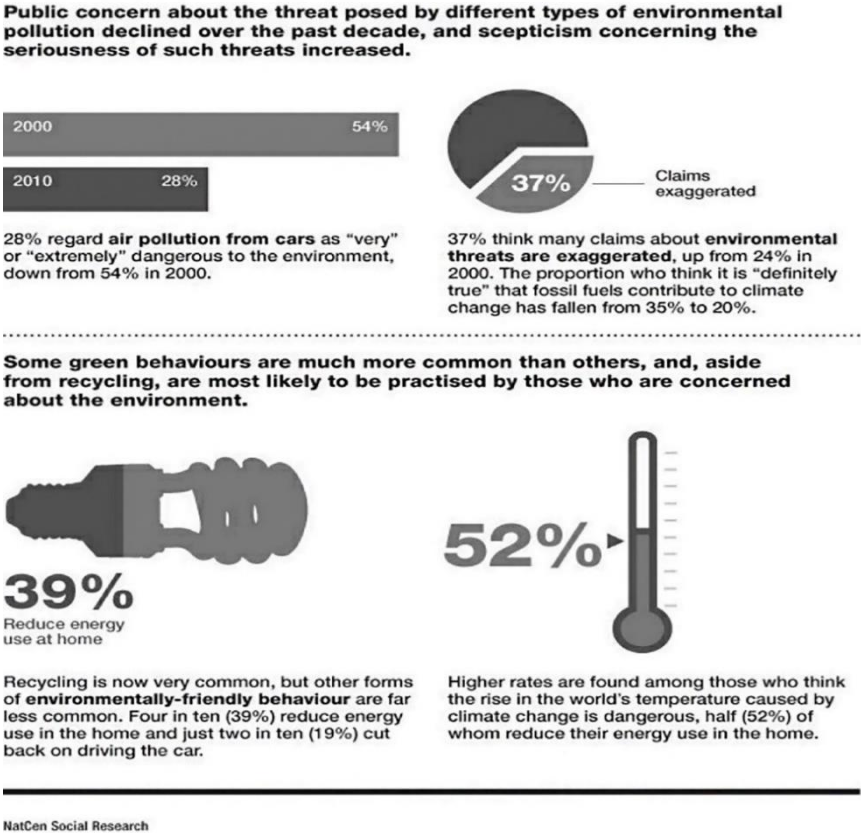


Figure 2.1: Waning interest in climate change threat (UK) (Taylor, 2012)

### 2.1.4 Responses to climate change

Responding to climate change involves making choices between mitigation and adaptation in risky encounters (NRC, 2012:28). *Climate adaptation* implies adjusting to the already occurring climate change and its outcomes (Kabani, 2016:2; IPCC, 2014:118). Thus, adaptation as a coping strategy involves actions meant to lower the long-term adverse risks of climate change to human life and property (Amekudzi *et al.*, 2017:4-5; Kabani, 2016:7).

On the other hand, climate mitigation involves interventions to lower the sources of heat-trapping GHGs and their harmful effects or enhancing their sinks to stabilise their concentrations in the atmosphere (Amekudzi *et al.*, 2017:20). Climate mitigation strategies include planting trees and managing forests and soils to serve as carbon sinks to capture the GHG emissions, using renewable energy and changing consumer behaviours (Amekudzi *et al.*, 2017:21-22; NRC, 2012:28).

### **2.1.5 Climate change in a developing economy context**

Like most African countries, Ghana's economy primarily depends on agriculture, energy and forestry, which are climate sensitive, for socio-economic development (Institute of Green Growth Solutions (IGGS), 2015:18; Besada & Sewankambo, 2009:9). Agriculture in Ghana depends mainly on rainfall and a large population of smallholder farmers who earn their living from the land (Arndt, Asante & Thurlow, 2015:7216). As the backbone of Ghana's economy, agriculture contributes about 30 per cent to the GDP, employs about 60 per cent of the labour force and supplies over 70 per cent of the national food requirements (Danyo & Osei-Bonsu, 2016:112). Changing climatic conditions in Ghana therefore poses a serious threat to agriculture and its output, the health and well-being of the people, water resources and energy generation (Kayaga *et al.*, 2020:3; Ministry of Food and Agriculture (MoFA), 2018:4; Pisano *et al.*, 2015:5; National Climate Change Adaptation Strategy (NCCAS), 2014:9-15; Besada & Sewankambo, 2009:9).

Ghana is vulnerable to climate change in at least, three ways that are crucial to the long-term economic development of the country. Firstly, agriculture is a major sector of the economy and largely dependent on rainfall and smallholder farmers (Arndt, Asante & Thurlow, 2015:7215; Asante & Amuakwa, 2015:79; IGGS, 2015:24). Secondly, Ghana has three different ecological and climatic zones, which range from the dry, hot Sahel area in the northern parts to the wet rainforests in the middle belt, to the savannah zone along the coastline. The northern regions in particular, are prone to climate change hazards like land and soil erosion, bush fires, flooding and droughts while the coastal regions are susceptible to sea level rise and erosion (MoFA, 2018:3; Stevens *et al.*, 2017:7; NCCAS, 2014:6). Thirdly, mining of natural mineral deposits such as bauxite, manganese, gold and diamonds in the forest regions of Ashanti, Bono, Ahafo, Eastern and Western, in particular, is gradually taking over arable lands that support cocoa, oil palm and other cash crops, as well as staple food crops that support the citizens in the country (Danyo & Osei-Bonsu, 2016:113).

Ghana is a signatory of the Rio de Janeiro Earth Summit accord and the Hyogo Framework for Action (HFA, 2005-2015; United Nations Framework Convention on Climate Change, UNFCCC, June 1992). In 2014, Ghana showed its commitment to advocate environmental sustainability by launching the National Climate Change Adaptation Strategy (NCCAS, IGGS, 2015:8; Yaro *et al.*, 2010:235). Ghana also launched a Climate Change Education in Schools programme which was also launched to serve as a trigger to deal with climate change challenges (IGGS, 2015:24; NCCAS, 2014:6).

The severity of the climate change situation in Ghana is further illustrated by media reports (GhanaWeb.com, 2017; Ghana Broadcasting Corporation, 2017) of widespread pollution of water bodies, destruction of farmlands and forests and in some cases, accidental death from drowning, mining pit collapse, and landslides as a result of illegal mining activities (locally referred to as *galamsey*, colloquial for “gather them and sell”), particularly in the cocoa-growing areas of the Asante, Central, Eastern, Bono and Western regions (Danyo & Osei-Bonsu, 2016:114; Ocansey, 2013). Illegal mining is causing soil erosion on a massive scale, deserts and marshlands, which are in turn depleting and decimating the flora and fauna in those mining areas (ISSER, 2022:1; Environmental Protection Agency, 2016). Ghana is also losing much forest cover in the headwater sources of prime rivers such as the Ankobra, Pra and Tano, leading to massive flooding, water pollution and disruption of farming activities in various communities during the rainy season (Danyo & Osei-Bonsu, 2016:115; Kessey & Arko, 2013; Yaro, 2010).

The call to promptly prevent the adverse effects of climate change from hurting the Earth to sustain humanity and the flora and fauna it supports (Vardoulakis 2015:299–300), highlights the circumstances of Ghana as a rain-fed agriculture-based economy that is highly susceptible to climate change (IGGS, 2015; Asante & Amuakwa-Mensah, 2015). The projection of developing economies suffering the most from increased droughts, floods and natural disasters (Iltus, 2015:3) resonates with this research study on extreme weather impacts in Ghana due to climate change (Kayaga *et al.*, 2020). Unfortunately, climate change education is not a prominent feature in Ghana’s higher education system (Boateng & Boateng, 2015:7).

#### **2.1.6 Raising awareness of climate change and environmental sustainability**

Global concern for environmental protection has heightened in recent times as society keeps consuming more of the natural resources that support life on Earth (Mason-Jones & Towill, 2016:39). Because the world hardly understands climate change (Krasny & DuBois, 2016), the



phenomenon must be tackled with “a continuous stream of activities, actions, decisions and attitudes that inform decisions about all aspects of life and also reflect existing social norms and processes” (Nelson *et al.*, 2007:397). The basis is that climate change has physical, social, cultural, economic and spiritual dimensions (Adger *et al.*, 2012; Hu & Chen, 2016:3).

Boon (2016:1009) recommends effective communication of climate change information hazards. There is also the need to educate people to use existing natural resources judiciously to alleviate the risks of the phenomenon to humans and the natural environment (Gustafsson & Ijla, 2016:459). To address the challenges, it is recommended that people are educated about climate futures to induce the needed behavioural change towards, adoption of positive attitudes and socially responsible behaviours towards the environment and climate change (Kagawa & Selby, 2010; Anderson, 2012:193). The premise is that sustaining the natural environment is in the collective interest of every human being on the earth.

## **2.2 Environmental sustainability**

*Sustainability* describes human interactions with ecological and climate systems, with environmental, economic and societal concerns (Malhotra *et al.*, 2013:1265). The term *sustainability* is rooted in Rachel Carson's book, *Silent Spring* (1962), which emphasised environmental conservation with respect to the damaging effects of pesticides on the natural environment and the health of humans and wildlife (Scyphers & Lerman, 2014:92; Dritz, 2014:8; Reckien *et al.*, 2017:170). Consequently, Jones, Hillier & Comfort (2016:38–39) has defined environmental sustainability in terms of the “preservation, utilisation and responsible use of the earth's natural resources”.

Sustainability has also been described by Morelli (2011:6) as “*meeting the resource and services needs of current and future generations without compromising the health of the ecosystems that provide them*”. Dritz (2014:7) has contextualised sustainability as “*striving to meet the needs of people, culture and business today in a way that restores the planet and does not compromise our ability to meet the needs of future generations*”. Sustainability also suggests “a continual process of actualising the possibility that humans and other life will flourish on the earth forever through consciously maintaining the balance between ecological, cultural, social and economic conditions” (Ehrenfeld, 2008:49 as cited in Reubens, 2010:12).

### **2.2.1 Sustainability strategies**

Sustainability strategies include “reducing the amounts of resources used, investing in recycling initiatives and renewable forms of energy and reusing materials where possible” (Janks, 2014:351–355; Malhotra *et al.*, 2013:1265; Whitehair *et al.*, 2013:65–68). The concept extends to the numerous agreements and laws that have been passed to regulate human activities such as mining, polluting, trashing and burning (Vardoulakis *et al.*, 2015:299–300). Reducing these human activities will curtail or reduce the risk they pose to the natural environment and life on Earth (Whitmee *et al.*, 2015:1973–1974). Climate change education is therefore recommended as a practical climate adaptation and sustainability strategy that can increase people’s preparedness to alleviate climate change impacts in the fight for sustainable futures (Stevenson *et al.*, 2017:3; Stevenson & Nicholls, 2017; Mochizuki & Bryan, 2015:5; Kagawa & Selby, 2010; McKeown & Hopkins, 2010:17-18).

### **2.2.2 Climate change education**

Education about climate change involves using teaching, learning and other classroom processes to increase public engagement with climate change to facilitate understanding of the risks and encourage positive attitudes and behaviour towards sustaining the natural environment (Hu & Chen, 2016:3; Capstick *et al.*, 2015; Ojala, 2012). The concept implies learning amidst insecurity, fast changes and ambiguity, which encourages critical thinking, problem solving, fast analysis of the dire consequences and decision-making. This process helps in getting people to analyse their challenge from various angles, to help them devise ways of addressing those problems (Stevenson *et al.*, 2017:1-2; McKeown & Hopkins, 2010:17–21). The idea is that teaching and learning processes can be used to equip people to develop the capacity to deal with this complex phenomenon called climate change.

Climate change education can encourage people to be concerned about climate change and the natural environment (Anderson, 2012:193; Kagawa & Selby, 2010). Consequently, climate change education must portray the crisis of sustainability as “the result of the breakdown of the interconnected systems in our world, which ought to be resolved according to their ecological, social, economic and cultural contexts” (Komiya & Takeuchi, 2006:2 as cited in Reubens, 2010:12). Hence, mainstreaming climate change throughout the school curriculum is recommended as an effective approach to equip people to develop the needed understanding and ability to tackle climate change hazards (Stevenson *et al.*, 2017:1).

In this sense, educating the current and next generations of citizens to appreciate the significance and impact of changing climate will encourage young people to help care for the environment and sustain it (Manzano-León *et al.*, 2021:3; Rajanen & Rajanen, 2019:254; Mishra *et al.*, 2015:122). The principle is that “education is one of the most powerful tools that can engage young people in the debate, prepare them for working with the green economy and give them the definitive science and facts about the biggest issue facing young people” (Dyster, 2013:3).

### **2.2.3 Climate change education, design thinking and experiential learning**

Climate change is a “wicked problem” (Lazarus, 2008; Scyphers & Lerman, 2014:95) because it is ill-defined and not fully understood. The phenomenon is often an abstract concept that people struggle to make meaning of (Iltus, 2015:3) and a difficult topic to communicate in appropriate messages for people to understand and act on (Malhotra *et al.*, 2013:1265; Moser & Dilling, 2004:34). An effective climate change education must define flexible learning strategies that induce learners to analyse communication, to query, make sense of issues, and develop critical and creative thinking to determine the appropriate actions required for counteracting particular risks and the general vulnerabilities of climate change (Anderson, 2012). This will help learners to develop competences that they can transfer to new, uncertain and poorly defined situations (Wals, 2011).

In this respect, an effective climate change education should promote hope in the learners and centre on ways of ensuring a green future (Ojala, 2015:134). Hence, sensitising people to the risks and hazardous impacts associated with climate change demands application of “out-of-the-box” thinking (Glasser, 2007 as cited by Stevenson *et al.*, 2017:2) or designerly ways of knowing (Cross, 2001:33) to solve the problems associated with climate change.

### **2.3 Design as a discipline**

Design has been defined as “a process of planning to arrive at outcomes, which may either be a service or a product” (Simonsen *et al.* 2014, p.1-2). It is an artistic way of exploring the manmade world and possibilities in the design process to generate ideas that enable solutions such as products, services and systems to be developed to serve particular human needs (Simonsen *et al.*, 2014: vii; Bratteteig, 2007:3). Design-based learning spaces are where students engage with and understand “designing as doing, knowing and becoming” (Snaddon *et al.*, 2019:4).

## 2.4 Graphic design and sustainability

Graphic design is both a profession and academic discipline. Also known as “communication design” and “visual communication” (Lou, 2017:117; Motley, 2017:231), graphic design uses visual elements such as typography, images, colour and space to convey ideas and communicate information. Modern day graphic design specialisations include print, websites, video, signage and user experience (Dritz, 2014; Debrah, 2020). As an academic discipline, graphic design is inherently practice-based, collaborative, involves beliefs about expertise and how one achieves that status (Motley, 2017:230). Hence, the teaching and learning of graphic design courses typically involve studio work, critique and exercises in the design process, which are professional design practices the students would follow in their future careers (Snaddon *et al.*, 2019:231; Motley, 2017:231-233; Boling *et al.*, 2016). In this sense, “the processes of designing and how to teach design are largely based on the profession’s tacit knowledge and experiences” (Appiah, 2014:40).

Besides online advertising, the output of graphic design usually takes the form of physical artefacts and services that include packaging, posters, billboards and outdoor advertising that are based on visual language (Cristina *et al.*, 2015:141; Yu & Sangiorgi, 2014:195–199). A typical example is packaging products that are created with plastic and other materials which are mainly non-degradable and become waste materials that pollute the environment (Mason-Jones & Towill, 2016:39; Janks, 2014:351–355; Grönman *et al.*, 2013:187–189). For this reason, the graphic design industry is tagged as part of the world’s environmental degradation problem (Grönman *et al.*, 2013:187–189; Manzini, 2007:3).

Graphic design practice has direct adverse effects on environmental protection, mainly because the industry relies heavily on natural resources like water and wood for its survival (Konchada, 2014:3). The paper manufacturing industry, for example, is cited as the third largest polluter of air and water bodies due to its use of large amounts of fossil fuels. The paper industry is also the biggest industrial user of water per pound of finished product. Printing ink and toner are the second largest users of carbon black from oil products (Grefé, 2003 as cited in Konchada, 2014:3). To reduce the harm on the ecological system, Benson, 2007 as cited in Konchada (2014) advocates that designers use renewable, biodegradable and/or reusable materials to reduce air and water pollution. Dritz (2014:8) also recommends that designers take advantage of recycled paper, use inks derived from vegetable sources, and produce PDF documents rather than prints.

This design approach is what Businessvictoria.com (2017) describes as “sustainable or eco-design” because it demands adoption of ethical behaviours towards environmental protection. Sustainable design underpins Benson’s (2007) idea of the negative social and environmental impacts of designers’ practices on the earth’s natural resources, in relation to the life cycle of design materials and products. Hence, a “sustainability conscious” graphic designer considers the connection between the “life cycle of a design” and the resources, production, delivery and usage to the “end-of-life” scenario of design products (Dritz, 2014:8).

In effect, sustainability and sustainable design demands that art and design practitioners rethink the approaches they use to produce their works and make meaningful decisions on how their designs impact humanity and the environment in which those designs are used (Debrah, 2020; Bonsu et al. 2020; Dritz, 2014). This suggests the need for graphic design education to build competences through design theory and practice to equip their professionals to be socially and politically conscious about sustainability. Sustainable graphic design should reflect the principles of sustainability, materials, processes and strategies that acknowledge the environmental, economic, social and cultural dimensions of sustainability (Dritz, 2014:8). It must also use the human-centred design thinking approach to assess the real needs of an intended audience and also create truthful and convincing messages that empower others to take sustainable action (Benson, 2007; Businessvictoria.com, 2017). In this regard, this study aimed to raise awareness about climate change and environmental sustainability issues so the students would understand the role that design and designers can play in addressing climate change through sustainable design practice.

## **2.5 Design thinking**

Design thinking is an “out-of-the-box”, creative, hands-on, inquiry-based and reflexive approach to designing solutions to address human needs (Debrah, 2020:51; Bjögvinnsson et al., 2012:101). As a way of developing and improving services, design thinking provides tools, methods and human-centred ways of solving complex or wicked problems (Liedtka, 2015:925–926; Debrah et al., 2015:6). The approach provides opportunity for designers to generate solutions and messages that ordinary people would understand and act upon accordingly (Moser & Dilling, 2004:35). It also provides an answer to the climate change problem in the sense that “what designers especially know about is the ‘artificial world’ and how to propose additions and changes to it” (Cross, 2001:54). The idea is that climate change education can be done effectively by focusing on “*designerly* ways of knowing, thinking and acting” (Cross, 2001:33).

### **2.5.1 Design thinking tools**

Design thinking has become central in contemporary design discourse and rhetoric (Bjögvinsson *et al.*, 2012:101) as a human-centred activity approach to problem solving (Brown, 2009:115 as cited in Siedel & Fixson, 2012:36). Design thinking describes the use of design methods to resolve challenging issues and make discoveries (Brown & Katz, 2011:381; Seidel & Fixson, 2012:1). The approach explores visual methods to identify the needs of people and how technologies can be integrated to provide what is needed (Brown, 2009). The process usually follows the way designers conceptualise ideas through sketching, prototyping and storytelling to arrive at innovative solutions. Design thinking “yields unlimited resources when designers from different disciplines collaborate with ordinary people to cross-pollinate design ideas and harvest solutions on climate futures” (Chisin *et al.*, 2014:183-185). Hence, the concept of design extends beyond producing artefacts and/or services (Cross, 2001:54).

Design thinking, as an approach to developing innovative solutions, is not exclusive to designers but can be accessed by other people to explore solutions via the design process (Brown & Rowe, 2008:1–2; Johansson-Sköldberg *et al.*, 2013:121–124; Liedtka, 2015:925–926). As an iterative process, it moves from generating insights about end users of products, services and systems, through the production and analysis of ideas, to the application of those ideas (Kimbell, 2012).

Application of design thinking in this study relates to the notion that climate change is not yet fully understood (Kagawa & Selby, 2010). Design thinking tools offer a vehicle for re-thinking the design process to advocate making a difference for sustainable futures (Manzini, 2007:3). The toolkit of design thinking includes observation, imagination, idea development, teamwork, quick learning, rapid building of models from concepts, and simultaneous research (Liedtka, 2015:928). It also enables the breaking of complex information into simple ideas that can be easily understood (Debrah *et al.*, 2015:6).

### **2.5.2 Methods of design thinking**

Three approaches to design thinking are evident in the literature. They are “needfinding”, “brainstorming” and “prototyping” to enable models to be developed from selected ideas (Brown, 2009; Lockwood, 2010; Martin, 2009 as cited in Seidel & Fixson, 2012:36). “Needfinding”, according to Verganti (2008 as cited in Seidel & Fixson, 2012:3), provides an opportunity to observe a situation in order to define an inherent problem. This first stage of initiating ideas draws

on prevailing technology and design experience to develop deep insight in the user environment through observation, understanding and engagement (Brown, 2009; Leonard & Rayport, 1997 as cited in Liedtka, 2015:925–926).

*Brainstorming* is the next stage after needfinding (Seidel & Fixson, 2012:5). The process involves group thinking to come up with new ideas beyond the researcher's own ideation, as well as the relevant techniques that could be applied to resolve the identified problems. The key advantage of brainstorming in a structured environment is the possibility of individuals building on other team members' ideas to generate a variety of skills and wisdom within the design community (Appiah, 2014).

Ideation leads to prototyping, the stage at which novel ideas are processed and developed into preliminary models that provide opportunity for designers to evaluate their ideas in relation to a defined approach, with the potential for further ideation. Prototyping, which applies to both products and the design of experiential services, is vital to the design process (Zomerdijk & Voss, 2011). These three design methods of needfinding, brainstorming and prototyping provide a basis for organisations to apply a “design thinking” approach (Siedel & Fixson, 2011:6).

This study adopted an experiential learning approach (Kolb & Kolb, 2017; Jose *et al.*, 2017) to expose graphic design students in a university of technology in Ghana to climate change and environmental sustainability issues so they would understand the need for sustainable design practice for protecting the natural environment.

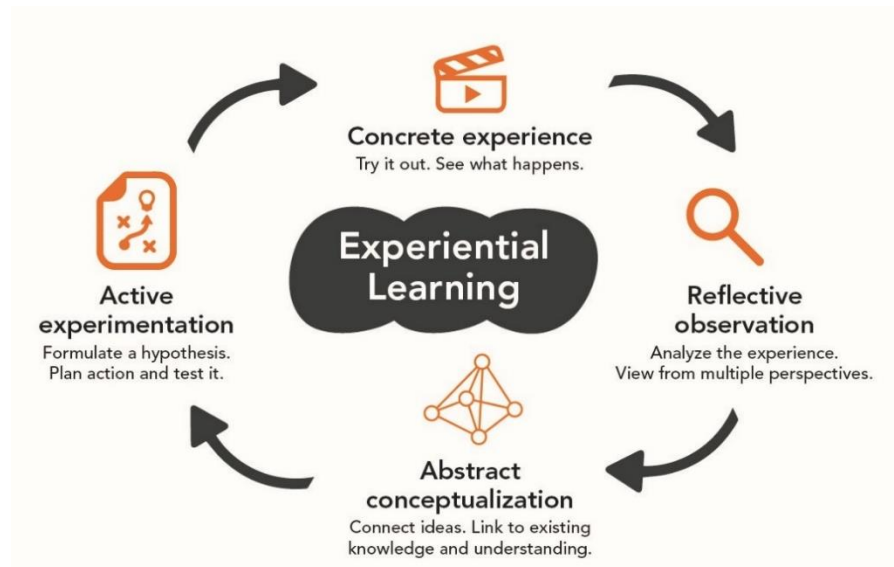
## **2.6 Experience as learning**

Experiential learning theory (ELT) emphasises the crucial role of experience in the process of learning (Kolb & Kolb, 2017:8). Most educators concur that students who actively participate in the learning process optimise their learning (Smart & Csapo, 2007). ELT is premised on the principle that experiential learning situations afford opportunity for learners to encounter course concepts directly so they gain a deeper grasp of those concepts and their practical functions (Kolb, 1984:41).

The explanation Kolb and Kolb (2017) offer is that experiential learning encounters do the following:

- “enhance the affective quality of the course content provided the students are engaged in solving problems as part of the activities and when they analyse, share, discuss and reflect on their personal reactions”,
- “significantly improve students’ memory for concepts insofar as the information gets stored in their autobiographical memory”, as well as
- “shape students’ beliefs about learning and about themselves, which can lead to significant personal insights, including a greater awareness of one’s personally-held perspectives and an improved awareness of other people’s experience, with the possibility of enhancing these attributes through critical reflection”.

In this sense, ELT views the process by which knowledge is gained through understanding and transforming immediate or concrete experiences that are derived from doing or observing as learning. This leads to reflecting on those experiences and processing them into mental impressions that enable the drawing of conclusions for action and active testing of actions to serve as guides to creating new experiences. This means the four-stage cycle (see Figure 2.2) is how learning occurs.



**Figure 2.2: Kolb's model of experiential learning** (Mohawk College, 2022)

In grasping experience, ELT explains that new information is perceived by experiencing actual or real-life situations and encounters which may demand the use of the senses and involvement. In another sense, experience can be gained by perceiving, grasping, or gaining information from symbols, representations via thinking, analysing, or planning. In this regard, effective learning that transforms experiences essentially requires that the learner goes through the entire cycle of the



two opposite dimensions of real experience and abstract conceptualisation, as well as the two polar opposite dimensions of reflective observation and active experimentation. This cyclical mode of learning-by-experience echoes the Chinese proverb “I hear and I forget, I see and I remember, I do and I understand” (Confucius, 551 BC-479 BC), a statement that highlights the need to provide learners with a means by which abstract concepts can be visualised to induce understanding (Hawtrey, 2007:144).

Experiential learning approaches date back to the late 1960s (Deif, 2017:359) as suitable ways of addressing many of the challenges in traditional education, particularly the cognitive and affective domains of learning. Gamification or game-based learning is one experiential learning approach (Deif, 2017:359) that facilitates interaction, collaboration, peer learning, active learning and simultaneously keeps students motivated in learning situations (Subhash & Cudney, 2018:192), an age-old challenge in education (Marzano-Léon *et al.*, 2021; Lee & Hammer, 2011). The idea is that games can arouse constructive reactions such as feeling focused, engaged and satisfied and motivate students to learn curriculum content in entertaining and relaxed ways (Sailer *et al.*, 2017; Dias, 2017; Subhash & Cudney, 2018:192).

## **2.7 Gamification**

Gamification relates to game-based learning in education. It is a game design strategy that encourages learners to interact with educational content in a way that significantly engages them to develop interest in learning and solving problems (Caponetto, Earp & Ott, 2015:55). Gamification empowers learners to invest time working to complete tasks, make learning attractive and helps to promote cooperative learning and other positive values like actual games (Martí-Parreño *et al.*, 2016:663–665). Although gamification is currently being applied in every aspect of life, we hardly recognise it. It has been installed in commerce, employment, health and, education, the object of this study, the area (Kapp *et al.*, 2020; Ofosu-Ampong, 2020:115; Wüncherlich *et al.*, 2020:273; Dichev & Dicheva, 2017:1; Bicen & Kocakoyun, 2018:75; Dominguez *et al.*, 2013:381). Gamification in Science, Technology, Engineering, Art and Math (STEAM) education has proved to be an invaluable strategy for motivating young people to develop skills and interest in caring for the environment (Manzano-León *et al.*, 2021:3).

Gamification has its roots in the elements of real-life games and, like games, it has rules to follow, may demand different levels of technology, provide learners with fun activities to do and infuse motivation and incentives into higher education activities (Kim, 2013). To Folmar (2015:5),

gamification “is not simply making a game, which imparts a lesson; it is applying game thinking to how we impart that lesson and continue to develop it based on the feedback from the players”. Ways in which gamification has been defined include those listed in Table 2.1.

**Table 2.1 Some of the definitions identified in the literature**

<b>Definition of gamification</b>	<b>Author(s)</b>
<i>The use of game mechanics in non-gaming contexts to extend user experience and engagement</i>	Deterding, Dixon, Khaled & Nacke (2011:2); Kiryakova (2013:1)
<i>The phenomenon of creating gameful experiences</i>	Koivisto & Hamari (2014)
<i>A range of activities that use game elements for non-game purposes</i>	Becker & Nicholson (2016:61)
<i>The application of game design techniques in primarily non-game environments</i>	Huotari & Hamari (2012:19)
<i>A process of using game-thinking and game mechanics to engage users and solve problems</i>	Zichermann & Cunningham (2011:16)
<i>The introduction of game elements in the design of learning processes</i>	Belloti <i>et al.</i> (2013)
<i>The application of game structure elements into educational materials</i>	Herout (2016:1049)
<i>The application of game mechanics in educational interventions to enhance motivation and engagement in learning tasks</i>	Dominguez <i>et al.</i> (2013:381)
<i>The application of game mechanisms in non-gaming environments with the aim of enhancing the processes enacted and the experiences of those involved</i>	Caponetto, Earp & Ott (2015:55)
<i>The introduction of games or gaming elements, such as what makes it enjoyable, into other areas of life</i>	Martí-Parreño <i>et al.</i> (2016:663–665)

<b>Definition of gamification</b>	<b>Author(s)</b>
<i>The phenomenon of creating gameful experiences or a process of making activities more game-like</i>	Hamari <i>et al.</i> (2014); Werbach (2014)
<i>The increase of engagement in some activity using game features and providing enjoyment and fun irrespective of the plan to change the learning content or not</i>	Al-Azzawi <i>et al.</i> (2016) Andrade (2016:2) Bíró (2014:150)
<i>The art of designing a learning process with game mechanics without changing the course content</i>	Kapp (2013)

These definitions of gamification only show slight differences in language, with no clearly defined meaning of the concept. What is commonly expressed is “the use of game design elements in nongame contexts” (Manzano-León *et al.*, 2021:3; Oforu-Ampong, 2020:115; Herout, 2016:1049). This perhaps underlines the assertion that gamification lacks a standard meaning, clear vocabulary and is difficult to define (Škuta & Kostolányová, 2016:422; Seaborn & Fels, 2015:16).

Gamification *design principles* refer to the aspects that define features of the gamified environment whereas *game mechanics* refer to the tools which help to realise the game design principles (Ollson, Mozelius & Collin, 2015). Thus, game-based learning implies the design of learning activities to present learning content and guiding them towards a desired end applies specific gaming values in real situations to engage the players (Trybus, 2015).

### **2.7.1 The gamification debate**

Like other emerging and motivational technologies, gamification has found use in the fields of marketing, online communications, social networks, wellness, crowdsourcing and environmental sustainability research (Seaborn & Fels, 2014:18). As a multidisciplinary concept, gamification has been applied in disciplines such as language learning, business, corporate training, psychology, health, technology, research, sustainability and education (Byrne, Ito & Furuyabu, 2022:56; Wunderlich *et al.*, 2020:371; Kapp *et al.*, 2020; Bicen & Kocakoyun, 2018:75; Deif, 2017:360). It has also been studied in different ways as a theory, a methodology and a practical tool that drives motivation (Seaborn & Fels, 2015:20). In spite of these positive impacts, particularly to improve

students' performance and increase engagement (Kapp, 2012), gamification has since its inception engendered much controversy among designers of games and user experience and researchers of human-computer interactions (Mahnič, 2014 as cited in Dichev & Dicheva, 2017:2).

This debate is rooted in certain scientific studies that attest to gamification having less impact on motivation and engagement than suggested by the hype (Broer, 2014 as cited in Dichev & Dicheva, 2017:2). There are even misconceptions about the application of gamification in learning contexts, which includes the notion that gamification is all about badges, points and rewards. This, however, ignores the aspect of the interactivity, storytelling, problem solving, motivation and game thinking that gamification affords learning and instruction in educational settings (Kapp, 2012:12-15).

Part of this debate also derives from Gartner's (2012) projection that 80 per cent of all gamification initiatives will fail by 2014 (Wunderlich *et al.*, 2020:371; Deif, 2017:2). Indeed, Ledda (2014, as cited in Deif, 2017:360; Landicho *et al.*, 2017:183) has explained that some gamification applications failed because the developers did not analyse the real needs of the users, what the learners did not know that required the gamification intervention, what the developers wanted the learners to do at the end of the *gamified* experience, and why those companies made gamification their goal. In contrast to the failed projection, Gartner (2013) also predicted that by 2015, more than 50 per cent of organisations who were engaged in innovation would *gamify* some components of their businesses (Wunderlich *et al.*, 2020:273; Caponetto *et al.*, 2015:50; Hamari *et al.*, 2014:1). Interestingly, Škuta and Kostolányová (2016:428) even proposed gamification as the fifth learning theory after the behaviourist, cognitivist, constructivist and connectivism learning theories.

In spite of these apparent setbacks, substantial efforts have been made towards leveraging the component of motivation inherent in the *gamified* approach for educational purposes. Consequently, this study argues for the promotion of gamification as a tool for teaching and learning about environmental sustainability within the graphic design curriculum in a higher education setting. This idea aligns with Froehlich's (2015:3) view on the successful application of gamification in environmental sustainability as a means of inspiring and provoking interest and positive behaviour towards the environment. It also aligns with the ideas of Chung *et al.* (2013). The premise is that gamification has the capacity to engage students and get them to participate fully and be interested in the content to be learned (Byrne, Ito & Furuyabu, 2022:56; Bicen & Kocakoyun, 2018: 75; Deif, 2017:371). The approach is also deemed a valued approach to induce

young students to ensure environmental sustainability (Manzano-León *et al.*, 2021:3; Rajanen & Rajanen, 2019:254).

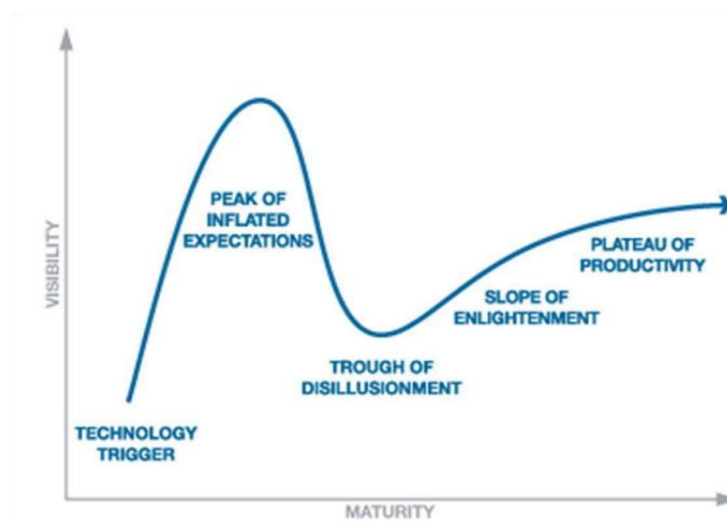
Interestingly, gamification emerged in the field of education from the search for answers to whether games and game-based strategies would fit into teaching and learning situations. The question was whether the motivation aspect of gamification (not the game itself), could be applied in education (Landers, 2014:756). The answer to this question, as Linehan, Kirman, Lawson and Chan (2011) have explained, hinges on the significant role motivation plays in student learning and success at school. The basis defined by Linehan *et al.* (2011) is the fact that motivation influences learners to spend time and energy to learn. Knowing that the motivation to keep going is a critical aspect of the learning environment is the factor that encourages the proponents of gamification to keenly push for the integration of game mechanics and principles in education. The simple reason is that games motivate engagement and are also well-liked by young people (Škuta & Kostolányová, 2016:427; Kalinauskus, 2014; Johnson *et al.*, 2014).

Considering that games motivate and engage and are also well-liked by young students (Pho & Dinscore, 2015; Kalinauskus, 2014; Johnson *et al.*, 2014), gamification advocates endorse proposals to combine principles and mechanics to encourage learning. Drawing from that, Froehlich (2015:21) underscores two conceptual illustrations about the relevance of persuasive technology and gamification in the context of environmental sustainability. Froehlich (2015:2) hypothesises that *green gamification* concepts are being applied to services such as *the Nissan Leaf* where service providers rank and reward fuel-efficient driving performance of their clients. Green gamification such as the *Recyclebank* (Froehlich, 2015:2) is also being utilised in sanitation service industry to monitor and reward home recycling behaviour. Thus, green gamification has become an emergent field of research interest that is beginning to affect almost every aspect of our daily lives and presents issues of *environmental psychology*, *eco-feedback* and *persuasive technology* (Pho & Dinscore, 2015:1; Kim, 2015:12).

Werbach (2014) supports Froehlich's point by describing gamification as "a version of persuasive design that can effectively promote motivation and persuasion". In terms of persuasive strategies and game design elements, Hamari *et al.* (2014) have established that gamification focuses more on arousing users' intrinsic motivations whereas persuasive technology targets social and communicative persuasion in addition to attitudinal change. However, in relation to the designing of Behaviour Change Support Systems for energy conservation, Huber and Hilty (2015) found some drawbacks in persuasive technology that caused them to propose four gamification-based

design ideas and methods for solving the problem. Moreover, in an attempt to merge game design and persuasive design, Orji, Vassileva and Mandryk (2017:3) mapped common game design elements to persuasive strategies via “an affinity diagram method” to design persuasive games for healthy eating behaviour. They, however, caution against adopting a one-size-fits-all strategy.

Regardless of the optimism associated with gamified learning, a well-designed gamification application that promotes and sustains desirable behaviour change seems to have no practical scientific basis. This notion underlines Gartner’s (2013) assertion that “the marketability of an emerging technology goes through a cycle that first climbs the “peak of inflated expectations” followed by a dive into the “trough of disillusionment” before it reaches the “slope of enlightenment” (see Figure 2.3), which indicates the phase where the benefits and limitations of the technology are understood and demonstrated (Gartner, 2013). Thus, gamification as a methodology and an emerging technology was thought to have reached its peak during the Hype Cycle in 2013 and was expected to reach the *productivity plateau* between 2015 and 2020 (Dichev & Dicheva, 2017:2).



**Figure 2.3: The Hype curve (Gartner, 2013)**

However, Dichev and Dicheva (2017) view the Gartner curve (Figure 2.3) as representing the mature and adoption phase of an emergent technology, which differs from gamification because it is both a technology and a methodology. In this sense, the authors attest to using Gartner’s model as a metaphor and a comparative model to depict the observable trends in emerging fields of research that show such *peaks of inflated expectations* and *slopes of enlightenments*.

Given the mass of research papers generated on gamification between 2010 and 2014, however, Dichev and Dicheva (2015:3) reviewed publications in 2014 to find out possible trends in the adoption of gamification in the field of education. The follow-up complementary research that was conducted in this growing field in 2015 sought to establish if any changes and new developments had occurred. By comparing and contrasting the findings of both reviews, Dichev and Dicheva classified their findings by means of a categorical structure according to topics they identified from discussions that included game elements, setting of gamification application, implementation strategy and evaluation results. This second study confirmed the capacity of gamification to motivate learners' engagement in tasks yet the authors drew conclusions that cautioned the need to conduct further study to establish the role of intrinsic and extrinsic motivators in the application of gamification (Dichev & Dicheva, 2017:25).

### **2.7.2 Games and playful learning**

Games are essentially activities that people participate in for enjoyment, competition and learning (Lahri, 2015). Games are “embedded in all human cultures and will continue to impact the social and leisure lives of people on a scale unprecedented and yet historically anticipated” (Seaborn & Fels, 2015:14). This includes traditional games that serve as tools to entertain, build relationships and train people to survive (Seaborn & Fels, 2015:14). Playing games serve as opportunities to actively engage people to spend time learning and having fun together and make them more productive (Buckley & Doyle, 2016; Kim, 2013). Games can also motivate and energise the individuals who engage in them (Nicholson, 2012:1).

Games are intended for pleasure but the same games can serve as tools that students can use to learn, experiment with concepts and strategies and complete assignments to earn rewards such as marks and letter grades (Gee, 2008; Appiah, 2015; Deterding *et al.*, 2011; Zichermann & Cunningham, 2011; Flatla *et al.*, 2011). Playing games is an indispensable aspect of learning and human living since learning occurs naturally while playing games (Korn *et al.*, 2017:31). As Gee (2007:3) as cited in Deif (2017:359) indicates, “you cannot play a game if you cannot learn it”, which probably suggests the ease of integrating games into non-gaming environments such as schools and higher education institutions to promote student motivation (Gündüz & Akkoyunlu, 2020:2).

Games are characterised by rules, feedback systems and goals, voluntary participation, enjoyment, measurable aftermaths, valuable results, player effort and investment of time, and

negotiable consequences, all of which have real life effects (Arnab *et al.*, 2015:404–405; Kim, 2015:1; Juul, 2011; Seaborn & Fels, 2015:16). Moreover, games are characterised by “interactivity, goals, quantifiable measures of progress/success and a definite ending” (Becker & Nicholson, 2016:63). Digital *games* are a relatively recent concept that has been defined by game designers, Salen and Zimmerman (2004:80), as “a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome”.

The lack of definition for “games” attest to the concept being hard to define (Seaborn & Fels, 2015:16). The notion of “games” can however, be easily recognised and games can be identified by at least, one of the specified characteristics (Becker & Nicholson, 2016). Educational gamification affords opportunity for the potential of games to be exploited (Bíró, 2014; Subhash & Cudney, 2017:192).

### **2.7.3 Gamification in education**

Commonly employed in marketing strategies, gamification is becoming more and more viable in education (Trybus, 2014:1). Gamification is being applied as a pedagogical tool to support learning in areas such as architecture, history, science, maths and for re-engineering traditional classroom education to align the needs of all learners, learning styles and reward systems (Al-Azawi *et al.*, 2016; Bíró, 2014:150; Watson *et al.*, 2011:466; Reinhart *et al.*, 2012:359; Caponetto, Earp & Ott, 2015:55). It has also been successfully applied in different educational settings with a focus on isolating the essential fun elements of games to align with the design of the target learning experiences (Oxford Analytica Ltd, 2016:4).

Application of gamification in education hinges on the conviction that integrating game mechanics without using the game itself, can engage learners in beneficial experiences and more generally, direct learner actions in desired ways (Škuta & Kostolányová, 2016:423; Holman *et al.*, 2013; Dichev & Dicheva, 2017). As a form of persuasive design, gamification infuses the characteristics, mechanics or design elements of games in a learning process purposely to encourage active learner engagement in ways that mimic what happens to players when they play games and solve problems (Codish & Ravid, 2015; Deterding *et al.*, 2011:381; Zicherman & Cunningham, 2011:29-32).

Gamification is not foreign to learning professionals who aim to design stimulating resources that can help to achieve their teaching objectives (Kapp, 2012). Teachers and trainers have used



game-like techniques and reward-based systems to manage learning in the classroom for many years (Becker & Nicholson, 2016:62-63; Froehlich, 2015:33; Kapp, 2012). Hence, educators who recognise that effectively designed game-based activities can promote significant returns in learning efficiency and creativity among students support the use of gamification in educational settings (Johnson *et al.*, 2014).

The advantages of gamification in education are exhibited through the way it engages learners in beneficial learning experiences, stimulating motivation and collaboration, as well as changing learner attitudes and behaviours in desirable ways. This is also seen in its ability to promote assignment completion, incorporation of exploratory and participatory learning methods and strengthening of student creativity and retention, even in higher education institutions (Caponetto *et al.*, 2014:55; Hamari, Koivisto & Sarsa, 2014; Werbach & Hunter, 2012:275; Werbach, 2014; Holman *et al.*, 2013). The idea is that educational gamification affords educators a pleasurable means to commit learners to learn the designed curriculum by motivating their actions and promoting learning and problem solving (Alsawaier, 2018:12).

Gamification is grounded on the principles of involvement, interaction, storytelling, imagination, problem solving, challenge, rewards, quick feedback and other elements associated with games (Dominguez *et al.*, 2013:381; Belloti *et al.*, 2013; Kapp, 2012; Appiah, 2015; Werbach & Hunter, 2012:275). Its major strength in education therefore lies in the ability of gamification to generate game-like and playful experiences that promote acceptable user behaviours and pleasure of use (Deterding *et al.*, 2013:3264). Thus, the gamified experience provides learners with a means to learn in a fun way.

Like real-life games, gamification in education provides learners with fun activities in relation to rules, different levels of technology, motivation and incentives (Kim, 2013). The principal consideration is that the gaming features and dynamics of gamification can engage and assist people to achieve their set objectives pleurably as “fun is the easiest way to change people’s behaviour for the better” (Kim, 2015:16). Thus, gamification increases efficiency, effectiveness, enthusiasm and active involvement in learning content by providing students with a flexible, student-centred environment that encourages cooperative, problem-based learning and other positive values typical of games (Alsawaier, 2018; Jo *et al.*, 2018; Dicheva *et al.*, 2015; Boyle *et al.*, 2011). This is why educators who recognise that effectively designed game-based activities can promote significant returns in learning efficiency and creativity among students promote gamification application in educational settings (Johnson *et al.*, 2014).

The core purpose of gamification is the motivation it induces (Tsay *et al.*, 2018). Essentially, motivation defines “the inner motive that drives people and encourages them to move towards a goal” (Hanus & Fox, 2015:153). In this respect, educational gamification aligns with John Dewey’s (1938, as cited in Kolb & Kolb, 2017:10) view that “motivation to learn fundamentally begins with the curiosity of the student”. The critical issue here is that gamification works by motivating those who voluntarily participate in the gaming process (Byrne, Ito & Furuyabu, 2022:56; Kalinauskas, 2014:69). In this sense, the successful adoption of gamification in educational contexts hinges on its status as “a psychologically driven approach that targets increasing motivation and engagement in learning tasks while also raising learners’ enjoyment over them” (Subhash & Cudney, 2018:192; Dichev & Dicheva, 2017:26; Hamari *et al.*, 2014).

Meaningful gamification therefore hinges on educational theories that include the Universal Design for Learning (UDL) and the Self-Determination Theory (SDT). The UDL presents the concept that “different learners use different methods to demonstrate competence relevant to their skills and abilities” (Seaborn & Fels, 2015:19; Becker & Nicholson, 2016:62). On the other hand, SDT defines the motivation that the individual brings to the learning situation and what can be done to sustain or increase it (Ryan & Deci, 2000; Andrade, 2016; Kalinauskas, 2014:69). Nicholson (2012) indicates that both UDL and SDT are strategies for educators to use elements of play, reflection and narrative to engage learners. An essential consideration for personalising a gamification programme is knowing who the students are, the types of games they play and how they relate to each other. Thus, the critical factors that make gamification work and ensure a motivational-developmental assessment are “the role of the context being gamified, the qualities of the users and the design quality of the gamified system” (Lefers & Birkenkrahe, 2016:12; Hamari *et al.*, 2014).

#### **2.7.4 Gamification in the classroom: old wine in new bottles**

Technology plays a complementary role in the 21<sup>st</sup> century as support for encouraging creativity and innovation in education. This is seen through the delivery and management of educational processes, improving the learning context, organisation of curriculum content and student involvement in activities. For example, web technology, interactive whiteboards and computer games are being deployed to support general teaching and learning in educational institutions. The support of this innovation becomes evident in the way technology is used to support creative approaches to teaching and learning (Bellotti, Berta, Gloria & Primavera, 2009, in Landicho *et al.*, 2017:183).

Recent advances in information communication technologies (ICTs) have led to the implementation of realistic virtual environments and simulations, where players can live compelling adventures while acquiring, practising and verifying knowledge presented by various pedagogical paradigms (Bellotti *et al.*, 2009). This represents a significant opportunity for 21<sup>st</sup>-century educators and trainers to enhance their educational toolkit. However, a major challenge lies in translating interest and potential into actual adoption and use. In this regard, more research is required to understand how to better design, administer and evaluate digital games across different learning contexts and target the potentials of digital games with respect to their interactivity, immersion and engagement (Ulicsak, 2010; Bellotti, Berta & De Gloria, 2010; de Freitas & Liarokapis, 2011, as cited in Landicho *et al.*, 2017).

*Serious Games* (SGs), which are *edutainment* (entertainment and education) in nature, are gaining more interest as an instructional tool that capitalises on the appeal of games and the effectiveness of ICTs (Korn *et al.*, 2017:32; Iltu, 2010). *Persuasive games* or *games for change*, as they are sometimes referred to, represent an innovative and superior approach to educating the public and addressing socio-cultural or emotional issues. In some cases, SGs have been more effective than other educational technologies or and conventional pedagogies (Ratan & Ritterfeld, 2009:10).

As Ritterfeld, Cody and Vorderer (2009:6) have explained, SGs denote “any form of interactive computer-based game software that has been developed with the intention to be more than entertainment”. In this sense, SGs must demonstrate the transfer of learning (to merit the tag *serious*) as well as engage and entertain (to be tagged as *games*). Maintaining the balance between fun and educational measures ought therefore, to be a priority throughout the development of SGs, starting from the design phase. However, educational games are challenged by limited incorporation of education and game design principles (Kiili & Lainema, 2008; Lim *et al.*, 2013).

The fundamental issue is that digital game designers and educational experts do not usually share a common vocabulary and perspective of the domain (Gunter *et al.*, 2006). There is, therefore, the need to improve the theoretical basis of the design of SGs with respect to the underlying pedagogic principles and the contexts of use (Bellotti, Berta & De Gloria, 2012). However, as Huynh-Kim-Bang *et al.* (2011) have pointed out, the principles of game-play and learning are different and frequently conflicting yet they coexist in well-designed SGs. This suggests that high-

level pedagogical intentions can be translated and implemented through low-level game mechanics.

By exploring complex learning goals, Kenny and Gunter (2008) deduced that learning content within a game could be immersed in the game's narrative elements. In this sense, game-based learning frameworks such as the *Four-Dimensional Framework* of de Freitas and Oliver (2006), and the game-based learning framework of Van Staaldunen and de Freitas (2010) seem to address similar issues as both recommend that game design should be based on considerations that are relevant to the traditional learning context. These ideas relate directly to such educational theories as exploratory learning, problem-based learning and inquiry learning that are well known in the pedagogy literature on learning theories (de Freitas & Jameson, 2012).

Moreover, the RETAIN (Relevance, Embedding, Translation, Adaptation, Immersion and Naturalisation) model designed by Gunter, Kenny and Vick (2008) assesses how well educational games contain and incorporate academic content and also promote transfer of knowledge. This model correlates with three learning theories that are most closely aligned with generally accepted game design principles, namely, Keller's ARCS (Attention, Relevance, Confidence and Satisfaction) survey model (Deif, 2017:360), Gagne's Events of Instruction and Piaget's ideas on schema (Westera *et al.*, 2008). The argument is that these frameworks serve as effective evaluation guidelines for analysing game design in educational contexts.

Further synthesis of existing practices, frameworks and models in the context of serious games design revealed limited consideration for serious game mechanics because they do not specifically target the relationships that exist between game mechanics and learning constructs, which constitute a key factor in game design for learning (Westera *et al.*, 2008). This brings in the need for a framework that is more comprehensive and explicit in terms of how learning components and game components are related, one to the other. In this connection, Huynh-Kim-Bang *et al.* (2011) emphasise that SGs should be designed in a way that effectively blends the principles of learning with game play, which defines the major challenge with SGs.

It is essential that some distinctions and similarities are drawn in respect of games and the classroom. Because both aim at creating compelling materials that will help to achieve learning goals, it takes a lot of work to create a game that is both fun to play and instructional (Becker & Nicholson, 2016:62; Kapp, 2012). The premise is that some students may not even perceive the gamified experience as playful or even interesting, mainly because student engagement and

motivation for learning is a major problem that often results in undesirable outcomes for some schools (Manzano-León *et al.*, 2021; Lee & Hammer, 2011:192). The idea is that lack of interest can lead to poor performance, cheating and learned helplessness (repeated failure and perceived lack of control over outcomes), which can cause some students to actively sabotage themselves by refusing to study and ultimately, drop out of school.

On the other hand, games are able to create an environment in which players accomplish tasks for intangible rewards like letter grades that are clearly less valuable than an education to any rational outside observer (Gee, 2008 in Deif, 2017). Moreover, games are able to break down the path to the final objective into smaller tasks, offer intermediary rewards along the way and encourage players to learn through experimentation by keeping the stakes relatively low and providing feedback in short cycles. Furthermore, games allow for failure and learning by trial-and-error, which is a natural element of any learning process and something professional graphic designers do regularly (Motley, 2017:231; Pho & Dinscore, 2015; Gee, 2008). This approach to learning, however, differs significantly between games and schools. Yet, it is important that failure is recognised when considering learner engagement, mainly because trial-and-error enables learners to practise and figure things out through repetition (Motley, 2017).

In this regard, Gee (2008) cites the example of *Angry Birds*, a game in which the player must launch a slingshot to destroy structures with birds to earn points. The structures are made up of blocks of various materials, and the birds have different properties and special abilities. In order to move on to the next level, the player must beat a minimum requirement of points; if the threshold is not reached, the player can restart the level with one button press. This short feedback time enables players to monitor their performance and progress and helps to avoid frustration. On the contrary, feedback cycles in the school environment are long and the stakes of failure are high, which fosters frustration, anxiety and disengagement (Lee & Hammer, 2011).

In this study that sought to deploy gamified lessons to convey climate change and environmental sustainability thinking to selected graphic design students and their educators in Ghana, the understanding was that gamification is a fun way to remodel traditional classroom education (Sandusky, 2016:1–5; Kiryakova *et al.*, 2013:1–2). The underlying consideration was that gamification is “a psychologically-driven approach that targets increasing motivation and engagement in learning tasks while also raising learners’ enjoyment over them” (Subhash & Cudney, 2018:192; Dichev & Dicheva, 2017:26). Besides, educational gamification is deemed a

valued approach for young students to learn about and take care of the environment (Manzano-León *et al.*, 2021:3).

## **2.8 Chapter summary**

The discourse so far demonstrates that since the onset of industrialisation, the earth's atmosphere has been filled with increasingly more carbon dioxide and other greenhouse gases, which has resulted in global warming and climate change. Although climate change is not yet fully understood, its effects have repercussions for the ecosystem and all the natural resources that sustain life on Earth. Both global warming and climate change pose a huge threat to the world's sustainability, making them a major global concern today. The two phenomena also put human life on Earth in danger. Therefore, there is a pressing need for the world to take practical steps to reduce the hazards of climate change in order to protect both the environment and humanity.

Climate change has become an urgent global concern and individuals and governments are being encouraged and inspired to work towards abating its unwanted impacts (Gustafsson & Ijla, 2016:459; Krasny & DuBois, 2016; Whitmee *et al.*, 2015:1973–1974). One critical challenge is how to create explicit messages to inform and enable people to understand the climate change phenomenon and its risks so they can respond appropriately towards sustaining the environment that supports life on Earth (Vardoulakis, 2015:299–300; Van der Linden, 2014:4; Moser & Dilling, 2004:35).

Education is, therefore, key to giving young people the crucial knowledge and abilities they need to comprehend the problems, claims and different points of view involved and to take constructive action steps to mitigate the current climate change issue. This study therefore aligns with the view that “designers and design researchers have a unique contribution to make regarding issues of climate change due to their multi-modal ways of thinking, doing and intuiting change and offering solutions” (Sevaldson, 2010 as cited in Chisin & Mainsah, 2014:7). Hence, this study in graphic design education makes a contribution to the global literature on knowledge and understanding of environmental sustainability, climate change and climate mitigation from the Ghanaian perspective. Chapter Three contains the details of the research design and methodology adopted to gamify the climate change and environmental sustainability learning offered to the selected graphic design students in the designated HEI in Ghana.

### **3 CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY**

This section of the thesis spells out the research design and methodology that were adopted to gather, organise and interpret field data for the study. The design strategy aimed to answer the research questions that guided the study, achieve the set objectives as well as the philosophical perspectives by means of utilising the Octalysis framework as a conceptual model and an analytical tool. The chapter describes the population studied and resultant participant selection method. Data collection strategies included design studio workshops. The chapter additionally defines the tools and methods used in applying gamification as a vehicle for conveying the abstract notion of environmental sustainability and climate change. Furthermore, it outlines the conversion of design thinking into graphic design education in Ghana.

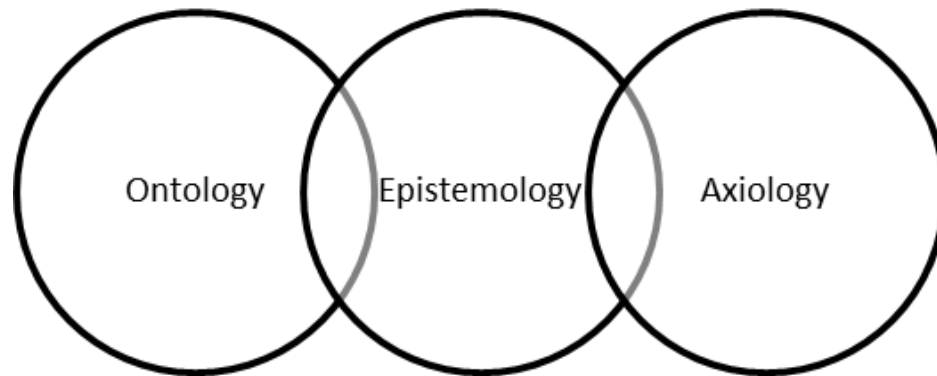
#### **3.1 Fundamental assumptions**

It was assumed that a large number of students in higher education institutions (HEIs) can play games. Students are often seen playing games either on their smart phones, computers or other mobile devices. Due to the fun elements that gaming offers, it was projected that through gamification, some of the fun elements of games could be applied and used as a tool to trigger learning experiences on environmental sustainability within the context of graphic design courses in HEIs. The phenomenon that was investigated in this case was climate change, which is often an abstract concept for people to grasp (Malhotra *et al.*, 2013:1265; Moser & Dilling, 2004:34). Hence, the assumption was that game-based learning would serve as a viable tool to advocate environmental sustainability and support the related behaviour adaptation and change among design students.

#### **3.2 Researcher's role and philosophical stances**

Research is based on some underlying philosophical assumptions about what constitutes *valid* research and which research method(s) is/are appropriate for the development of knowledge in a given study (Thomas, 2010:291). Three main philosophical perspectives underpinned this research. These were the ontological, epistemological and axiological stances. My perspectives in relation to the philosophical stance and how I applied it in the context of the research are expounded upon in the following sections and illustrated in Figure 3.1.

### 3.3 Research design



**Figure 3.1: Diagrammatic view of philosophical stance** (Author's construct)

#### 3.3.1 Ontological stance

Ontology is the study of the nature of existence and how one perceives the nature of reality (Terrell, 2016:154; Wahyuni, 2012:69; Gray, 2010:17). Ontology embodies the understanding of “what is” or “what we may know” which informs the process of creating knowledge in a given research (Collins, 2010:91). The principle is that knowledge is co-constructed through perceptions and social interactions with actors to give meaning to reality. As a design researcher, my ontological perspective is that reality is determined by social actors. Hence, individuals contribute ideas and experiences to generate knowledge on social phenomena in a given research study. This research study was situated within the subjectivist adopter theory paradigm (Wahyuni, 2012:69–70; Gray, 2010:17), which informed my epistemological stance (constructivist research paradigm) to generate knowledge.

#### 3.3.2 Epistemological stance

Epistemology deals with the nature of knowledge (Sarantakos, 2013:29) and our beliefs about our role in the research process (Terrell, 2016:154). Epistemology provides an understanding of what it *means to know* or *how we come to know what we may know* (Gray, 2010:17). This then defines the relationship between *the knower* and *the known* (knowledge) and facilitates decision-making on what kind of knowledge is appropriate and suitable in each research study (Gray, 2010:16-17). The epistemological stance in this research study is constructivism or the social constructivism philosophy (Creswell & Creswell, 2018; Wahyuni, 2012:69–70; Thomas, 2010:301), which views knowledge and meaning as co-constructed. As a design researcher, I argue that human



experiences shape the knowledge and outcomes that may be obtained in a given research study. Data for the study were therefore collected qualitatively through design research methodologies so knowledge was co-constructed with the study participants during the data collection process. This made me part of the knowledge creation process (which is subjective) due to my philosophical worldviews as a constructivist (Creswell & Creswell, 2018; Wahyuni, 2012:70–71). The goal was to understand as much as possible, the participants' views of the phenomenon studied, which was environmental sustainability.

### **3.3.3 Axiological stance**

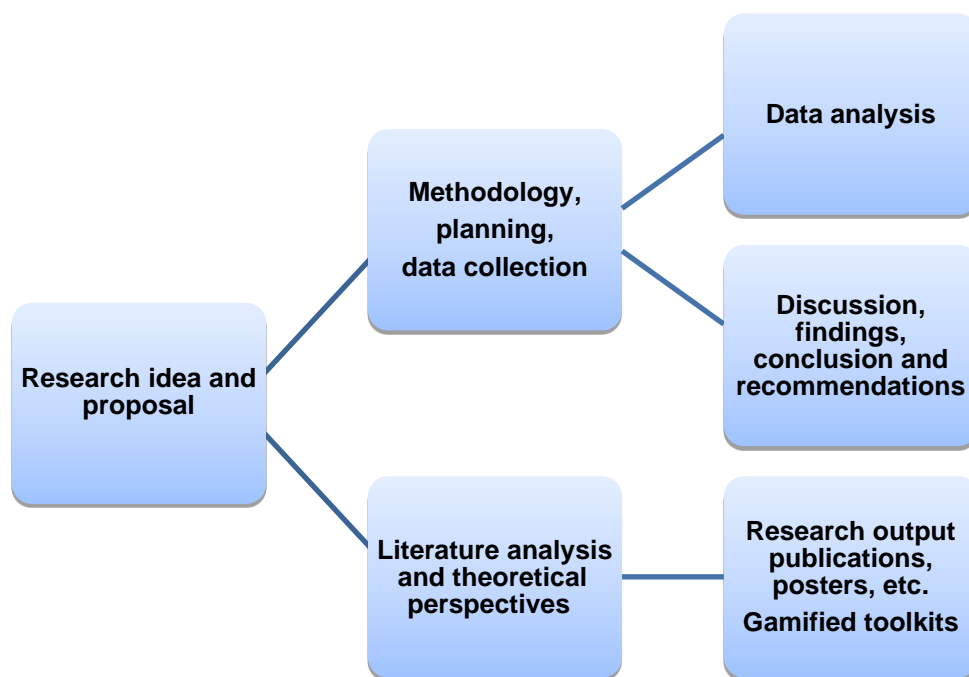
Axiology is concerned with ethics. It is the researcher's belief about what is ethical and valuable (Terrell, 2016:154). In terms of axiology, I acknowledge that the research is value-laden as it dealt with humans. The emic approach (*insider's perspective*) was the axiological stance (Creswell & Creswell, 2018). Therefore, the researcher and what was researched cannot be separated, thereby making it highly subjective. The study was conducted through a design ethos to ensure that the research conducted is value-bound and emic (Wahyuni, 2012:70). As such, the data collected comprises personal perspectives of the participants and my personal views during reflections on the topic. Efforts were made to maintain neutrality in the interpretation and expression of data in the research (Collins, 2010:95).

Research design is the plan a researcher devises to describe the population from whom data will be gathered, the frequency of collection and at what point the data will be analysed (Terrell, 2016:97). It provides a general framework for the research procedures and the methods to be employed for data collection to answer the research question. Research design provides the basis for establishing the validity and reliability of the study and eventually, its quality and accuracy (Bryman & Bell, 2015). In effect, the term describes what the researcher will do from data collection to its analysis in order to answer the research questions (Cooper & Schindler, 2011:139). On the other hand, methodology defines the specific procedures and step-by-step plan the researcher develops to answer the research questions (Terrell, 2016:260).

This study was conducted using design research methodologies. These are qualitative in nature, human-centred and widely used in design inquiry (Nova, 2015:19-22). Design research is conducted through design, a practice-based, and hands on, iterative process that largely engages different people in the design process. It is visually based and combines methods from ethnography to explore design thinking strategies which sometimes end with an action that

describes future scenarios (Nova, 2015:19-22; Bratteteig, 2014:13). Design research is usually explored through participatory methods such as co-design until the desired results are obtained (Sanders & Stappers, 2014:10-11; Seidel & Fixson, 2011:3-5). More specifically, the principles and practices of participatory design research were adopted. These methodologies are often reflexive and flexible and do not follow a linear research design methodology (Frauenberger *et al.*, 2015:93–94). These design methods were selected to provide rich and valuable visual data from the perspective of the participants within the instructional context of graphic design.

In this regard, the research design and methodology illustrated in Figure 3.2 was employed to meet the main research milestone, which aimed at exploring gamification as a pedagogical tool to enhance graphic design students' engagement with environmental sustainability.



**Figure 3.2: Research design and methodology** (Author's construct)

### 3.4 Research methodology

Design research methods were found to be the most appropriate for conducting the research because gamification or game-based learning is human centred (Chou, 2015). Gamification has proved to be a viable tool that can be used to re-model traditional classroom education (Kiryakova *et al.*, 2013:1–2; Sandusky, 2016:1–5). However, there are many dynamics involved that need to

be integrated into the design of any given gamified learning experience in the transfer of knowledge in non-gaming contexts (Šćepanović, 2015:1). Yu-kai Chou explains that gamification is a human-focused enterprise yet games are usually designed with much focus on the function rather than focusing on the human aspect of the game-design (Yu-kai Chou in Majoor & Eliens, 2012:4). However, Yu-kai Chou believes that game designers should focus on human desires and what motivates users in order to achieve the desired action in the gamified learning experience. The rationale is that “a design that is not accessible enough will receive inappropriate emotional responses, which in turn may discourage players from using the gamified application again” (Doumanis & Smith, 2015:25). Hence, the emotional elements play an integral role in the design of gamified experiences.

Consequently, Yu-kai Chou proposed the Octalysis framework with eight core drives (see Figure 3.3) to serve as an analytical tool that could inform the selection of gaming elements to improve the overall human experience.

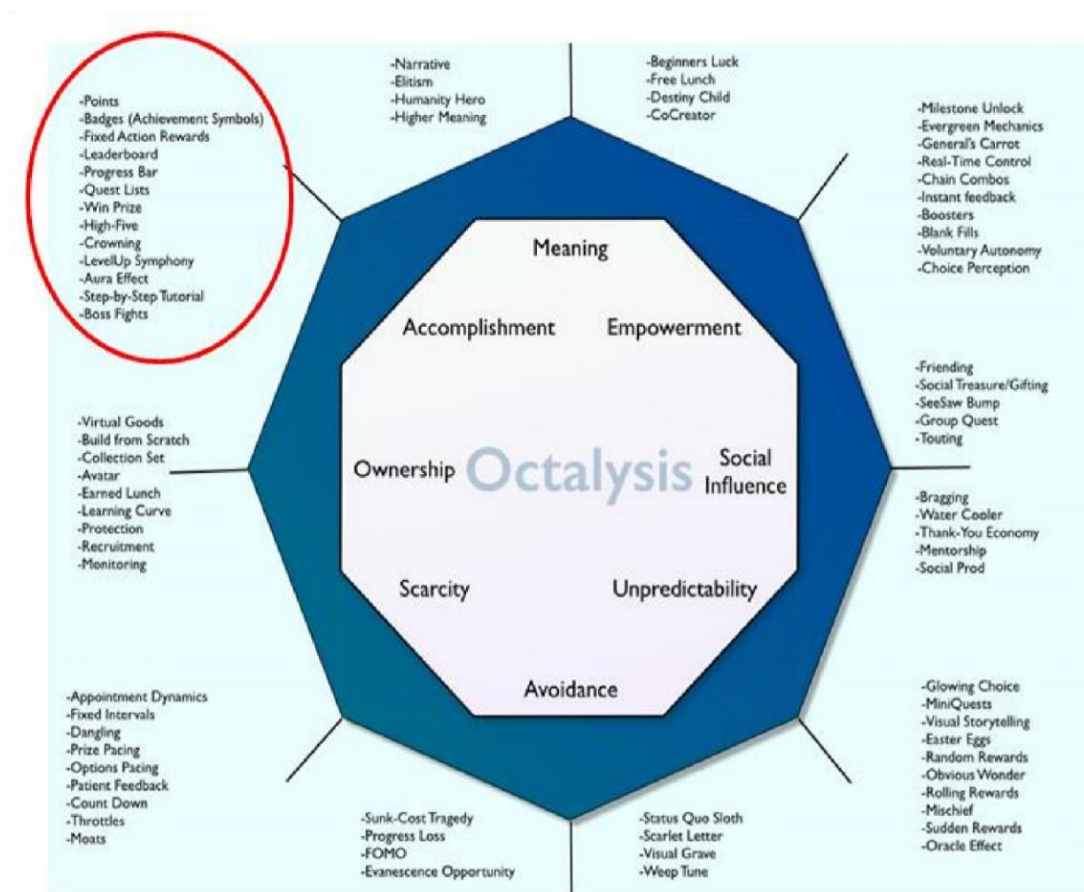


Figure 3.3: The eight core drives and relevant game elements (Yu-kai Chou, 2012)

The research design for this study was informed by three out of the eight core drives of the Octalysis model that motivate humans in gamified experiences. The selected core drives are *Epic meaning and calling*, *Development and accomplishment*, *Empowerment of creativity and feedback*. They are located in the upper part of the Octalysis and are mainly used for *White Hat* gamification.

In theory, the Octalysis framework consists of two major parts in an octagon, which represent *white hat* and *black hat* gamification. The eight main drives of the Octalysis are located in the upper and lower parts of the octagon respectively and are referred to as *white hat core drives* and *black hat core drives*. In principle, the drives in the upper octagon are suitable for *white hat gamification* whereas the drives in the bottom of the octagon are functional for *black hat gamification* (Chou, 2016:120).

The concept of *white hat* and *black hat* is borrowed from Search Engine Optimisation (SEO). *White hat SEO* refers to designing and promoting websites to function such as Google where your site is then ranked according to how often users search for related terms. On the other hand, *black hat SEO* refers to procedures that are unethical and used to exploit the selected rules, robustness and weaknesses of search engines to get sites highly rated. Hence, in the realm of *SEOs*, *black hat* is highly discouraged (Chou, 2016:119–122). However, in game design, the core drives of *white hat gamification* are obvious. Meanwhile, *white hat gamification* presents some disadvantages in that it creates no sense of urgency. *Black hat gamification* on the other hand, makes us feel obsessed, anxious, addicted and eventually makes players feel they have lost control of themselves (Chou, 2016:123).

One example of such a social game is Pokémon, which employs both *black hat* and *white hat* gamification techniques that may be perceived as design driven (see Figure 3.4). Although both techniques are required to achieve a successful game design, they must be done with much consideration to design ethics.



Figure 3.4: Pokémon games (Google images, 2016)

These three Octalysis core drives were applied because they focus on the positive side of gamification. Also, they provide techniques that make players feel good and powerful. Users are able to express their creativity during the process of play, giving them a higher sense of meaning (Chou, 2015:1).

Additionally, selecting *white hat gamification* made it possible to integrate the human aspect into the design and development of the gamified learning experiences. The understanding was that *white hat gamification* techniques could influence behavioural change towards environmental sustainability. Hence, the study was conducted through Human-Centred Design (HCD) approaches. It was envisioned that the combination of these concepts as the foundation of the study could inform the design of the gamified learning experiences and provide an alternative approach in design education. The three core drives that were selected to inform the study are:

- Epic meaning and calling
- Development and accomplishment,
- Empowerment of creativity and feedback.

These are described briefly in Table 3.1.

**Table 3.1: Brief description of the selected core drives**

Description of selected core drives in the Octalysis framework (white hat gamification)	Key elements in the selected core drives	Contextualising Octalysis for the research case
<p><b>Core drive One:</b> <i>Epic meaning and calling</i>: the need to participate in something bigger than yourself</p>	<p>Narrative            Elitism            Humanity hero            Higher meaning            Beginner’s luck            Free lunch            Destiny child            Co-creator</p>	<p>Advocating environmental sustainability and climate change</p>
<p><b>Core drive Two:</b> <i>Development and accomplishment</i> drive motivates people towards a specific goal and accomplishing it.</p>	<p>Points            Badges (achievement)            Fixed action rewards            Leaderboard            Progress bar            Quest lists            Win prize            High-five            Crowning            Level-up            symphony            Aura effect            Step-by-step tutorial            Boss fights</p>	<p>To be tailored towards achieving the goal of environmental sustainability.</p>
<p><b>Core drive Three:</b> Empowerment of creativity and feedback</p>	<p>Milestone            unlock</p>	<p>Making people feel better because they have improved the</p>

Description of selected core drives in the Octalysis framework (white hat gamification)	Key elements in the selected core drives	Contextualising Octalysis for the research case
	Evergreen mechanics General carrot Real-time control Chain combos Instant feedback Boosters Blank fills Voluntary autonomy Choice perception	environment and incorporated other elements of sustainability into their activities.

The selection of the three core drives for this study reflects the positive aspect of gamification in order to take advantage of the “feel good and powerful” factor and give the players a “higher sense of meaning” (Chou, 2015:1). Hence, data in this study were collected from the participants mainly through observation, interviews and participatory design methods such as brainstorming and co-designing (Manzini, 2015; Bratteteig, 2014:13; Siedel & Fixson, 2011:3-5). This multiple methods data collection strategy was meant to strengthen the type of findings that could emerge from the gamified learning activities that aimed to find answers to the questions posed to the study participants on the two concepts of climate change and environmental sustainability. It also served as a means of triangulation in order to enhance confidence in and demonstrate reliability of the research findings (Creswell & Creswell, 2018; Cohen, Manion & Morrison, 2018; Bryman & Bell, 2015).

### 3.4.1 Octalysis framework as a conceptual model and analytical tool

A conceptual framework determines how a researcher formulates the research problem and how to investigate it and derive meaning from the data that would be gathered (Lederman & Lederman, 2015:1). Similarly, Imenda (2014:188-189) explains a conceptual framework as “a model that

symbolises an ‘integrated’ way in which a researcher explores and interprets or explains events or the behaviour of the entities or events studied”. Essentially, a conceptual framework assembles related concepts to explain or predict a given event to make the research problem more understandable. The Octalysis framework (see Figure 3.3) developed by Yu-kai Chou (2012) was adopted as the conceptual framework in this study.

Yu-kai Chou’s Octalysis framework was selected as the conceptual model for this study because it elaborates what drives those who play games and the drivers that enable the games to achieve the purpose for which they are designed, which is to engage the user. Proposed as an analytical tool that could inform the selection of gaming elements in order to improve the overall human experience, the eight main core drives of the Octalysis that motivate humans in gamified experiences represent each side of the octagon and are grouped into two subcategories.

The fact that gamification is a human-focused design method with significant implications for the role of emotional elements in the design of gamified experiences, was key to choosing Yu-kai Chou’s (2012) concept of gamification (see Figure 3.3) as a tool for achieving the objectives of this study. Hence, I adhered to Yu-kai Chou’s advice to focus on human desires and what motivates users in any gamified learning experience (Majoor & Eliens, 2012:4) in order to achieve the desired action. Placing the human aspect of game-design over its function also aimed at making the designed gamified learning experience accessible enough to receive the appropriate emotional responses that would encourage players to want to use the application again (Doumanis & Smith, 2015:25) if the design educators decided to subsequently incorporate it as a teaching tool.

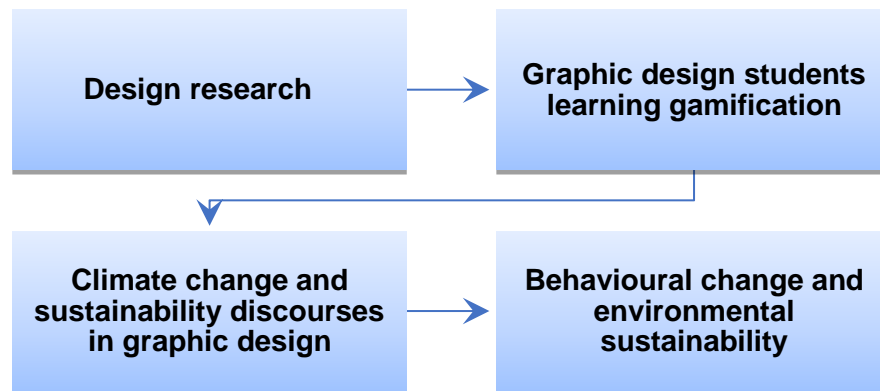
In this study, the core drives in the *Octalysis* model served as an adjustable framework to inform the design of gamified tools and the learning experiences on environmental sustainability in this research case. The *Octalysis* model was suitable for this research study since the selected framework focuses on the *human aspect* of gamification. It was envisioned that the combination of these concepts as the foundation of the study could inform the design of the gamified learning experiences and provide an alternative approach in design education.

Gamification workshops were designed to serve as a pedagogical tool for examining the participating students’ perceptions of environmental sustainability and climate change matters within the non-gaming context of design education. The gamified learning experiences were explored through design-led activities with the participating graphic design students. The aim was



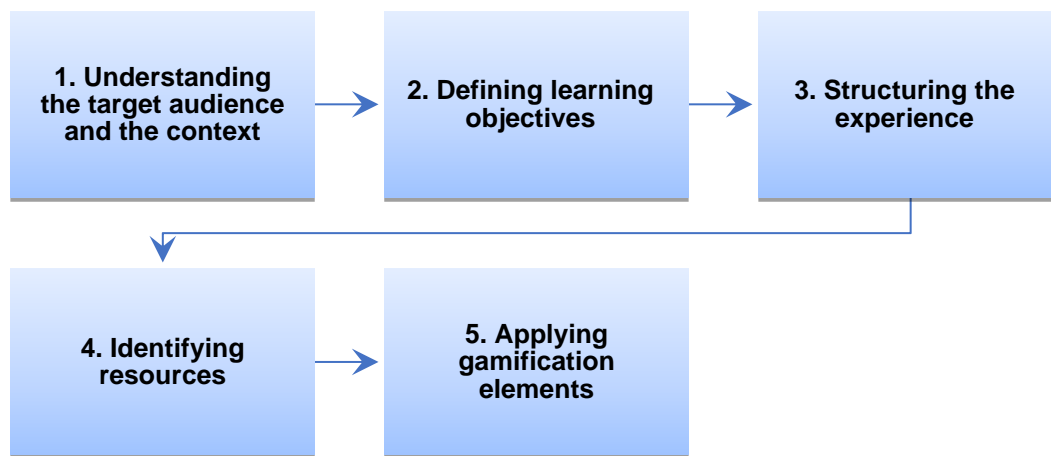
to get the students to appreciate the two abstract concepts of climate change and environmental sustainability in this non-gaming context of design education in the university. Hence, the information that was obtained from the participating design educators served to gauge their willingness to promote environmental and sustainable design practices through game-based learning.

The interrelations between the main concepts of the study illustrated in Figure 3.5 served as the categories for organising the game-based learning activities using design research methods.



**Figure 3.5: The relationship between the main concepts in the study** (Author's construct)

The students' perceptions on environmental sustainability and climate change matters were examined using gamification as an instructional tool within the non-gaming context of design education. The game-based tools and mechanics that were explored as part of student learning on environmental sustainability in the participatory design workshops was based on the five-step process proposed by Hsin-Yuan *et al.* (2013:7) and depicted in Figure 3.6.



**Figure 3.6: A five-step process to applying gamification in education** (Hsin-Yuan, Huang & Soman, 2013:7)

The five-step process enabled the integration of gamification as a pedagogical tool within the selected graphic design research context. The research however, focused mainly on the fifth step (applying gamification elements) to enable the application of gamification elements as part of the sustainable design course.

The gamified workshop activities corresponded to the research objective that sought to develop a gamification framework that could guide the teaching of environmental and sustainable design practices within the selected context. Using gamification as a teaching tool inside the non-gaming framework of design education made it possible to test the students' perceptions on issues relating to environmental sustainability and climate change.

### **3.4.2 Unit of analysis and observation**

The unit of analysis or unit of observation are often the same in research activities and are also used interchangeably (Fraenkel, Wallen & Hyun, 2012:395; Yin, 2009). Unit of analysis refers to the "who" or "what" that is being studied, which enables the researcher to create summaries or make inferences based on them (Babbie, 2012). The units of observation in this study were graphic design students and design educators at a selected HEI in Ghana. Another unit of analysis was the kind of games the students play and the learning experiences they derive in the process.

The design students' outcomes of environmental and sustainable design practices that were elicited through the gamified learning and participatory design activities were an additional unit of analysis. The graphic design projects the students designed and created in the workshop activities

to demonstrate their understanding of climate change and environmental sustainability, also formed part of the unit of analysis. This exercise gave a microscopic insight into the students' views on environmental sustainability, sustainable graphic design practice and the role that design and designers can play in addressing climate change. The design educators at the HEI formed another unit of observation. Information obtained from the participating design educators provided a valuable means to promote environmental and sustainable design practices through game-based learning.

### **3.4.3 The research site**

The study was conducted in an HEI of technology in Ghana. The selected HEI is the premier institution that trains designers for the operational to management levels of the local graphic design industry in Ghana. As such it was suitable to use this institution for the study. Access to the site was negotiated through an Advertising and Media Management educator who volunteered to host the study and also helped to secure the approval of the head of the Graphic Design department. Both of these individuals actively participated in the study. For ethical reasons and in line with the principles of qualitative research (Bryman & Bell, 2015; Creswell & Creswell, 2018; Cohen, Manion & Morrison, 2018; Gray, 2010:73–87), the identity of the HEI, the graphic design educators and students who participated in the study are withheld for confidential purposes.

### **3.4.4 The population studied**

The population that was studied were 165 third-year undergraduate graphic design students and five educators from the Department of Graphic Design in the premier HEI of technology in Ghana. This selection was suitable to aid in achieving the main research objective of exploring gamification as a pedagogical tool to enhance the graphic design students' engagement with climate change and environmental sustainability. Participation in this study was on a voluntary basis. Gender played no role in the selection of the population studied and the analysis of the data obtained from the survey.

At the time of the study, the Graphic Design department had twelve teaching staff across the various courses and three hundred and fifty undergraduate students spread across the three graphic design specialisations of Multimedia and Photography, Filmmaking and Animation, and Advertising and Media Management. The names of the three specialised course options also represent the sections of the Graphic Design department of the selected HEI.

### **3.4.5 Sample and sampling technique**

The purposive sampling technique (Creswell, 2014:239) was employed to choose the sample units for the research. This sampling technique implies “purposefully selecting participants or sites (or documents or visual material) that will best help the researcher understand the problem at hand and the research question(s)” (Creswell & Creswell, 2018). In purposive sampling, “the researcher selects individuals and sites for a study because they can purposively inform an understanding of the research problem and central phenomenon in the study” (Creswell, 2007:125). This non-random method of sampling allows the researcher to select “information-rich cases for in-depth study” (Coyne, 1997:1; Thomas, 2010:23, 313). Also referred to as intentional sampling, this technique enables the researcher to choose the study population “on purpose” because they have the best information concerning the study (Terrell, 2016:75; Creswell, 2015). In this respect, Creswell (2014:239) notes that “qualitative research requires a purposeful selection of study participants, research sites, documents or visual materials that will best help the researcher to understand the problem and address the research question in order to produce valid research results”.

Obtaining information-rich content for this study of gamified learning in a graphic design education context meant purposively selecting design-education participants. Overall, the sample studied consisted of one hundred and sixty-five students and five graphic design educators in the department of Graphic Design in the selected HEI of technology in Ghana. The aim was to gain rich data for the study. The design educators were selected to participate in the study because as the teachers of the graphic design courses, their views on environmental issues and sustainable design practices would be informative and critical to the success of the entire research process and its findings.

The one hundred and sixty-five undergraduate graphic design student participants were pursuing three different specialised graphic design courses. These are Advertising and Media Management, Filmmaking and Animation, and Multimedia and Photography. There were sixty-seven students in Multimedia and Photography, nineteen in Filmmaking and Animation, and seventy-nine in Advertising and Media Management, respectively. Each specialised course and its corresponding set of students had at least one design educator included. There were two educators for Multimedia and Photography, two for Filmmaking and Animation and one for Advertising and Media Management. The two groups of participating students were third-year

undergraduate students taught by the Advertising and Media Management course educator who volunteered to host the study.

#### **3.4.6 Multiple method data collection**

Data in this study were collected from the participants through observation, interviews and participatory design methods that involved brainstorming and co-designing (Bratteteig, 2014:13; Siedel & Fixson, 2011:3-5). Hence, a multiple methods data collection approach was used for collecting data from the participants in this study. Specifically, the strategy involved data collection via participant observation, informal and semi-structured interviews, questionnaire administration and design studio activities, which form part of qualitative enquiry instruments (Creswell, 2014:239). Observation, interviews and questionnaires are typical research instruments often used for gathering qualitative and quantitative data (Leedy & Ormrod, 2005:114).

This integrated approach to data collection was adopted to deepen the type of findings that could emerge through the gamification activities that sought answers from the participants on the questions that emerged from the investigation on environmental sustainability. Moreover, “purposeful data integration enables researchers to seek a more panoramic view of their research landscape, viewing phenomena from different viewpoints and through diverse research lenses” (Shorten & Smith, 2017:74).

Since the research was design related, visual-based design methods such as photographs, audio and video recordings, storytelling and brainstorming in design thinking workshop activities (Heather & Walters, 2016:40-42; Nova, 2015:19-22; Gray & Malins, 2004:72) were largely used for data collection. The data gathered were the design students’ ideas on climate change and environmental sustainability. Additional data were collected via participatory design methods such as brainstorming and co-designing (Bratteteig, 2014:13; Siedel & Fixson, 2011:3-5). The design methods were selected to provide rich and valuable visual data from the perspective of the study participants within the instructional context of graphic design.

Information obtained from the participating design educators served as a valuable resource to gauge their preparedness to promote environmentally-friendly and sustainable design practices through game-based learning.

### **3.4.7 Interviews**

In this study, informal interviews (Creswell, 2014:239) were conducted in a face-to-face manner with the five graphic design educators and the Phase 1 group of 75 students to obtain their views on environmental sustainability and climate change matters. All five educators were interviewed as individuals. Open-ended questions gave the respondents complete freedom of response in their own words (Bryman & Bell, 2015). Open-ended questions are recommended when posing a complex question that has no ready or apparent answer and in situations where we are interested in obtaining the respondents' unique views on an issue or topic (Ruane, 2005:131). The students' interviews were conducted using mostly unstructured and open-ended questions.

All the 75 Phase 1 study participants were informally interviewed as a class and in focus groups of ten to twelve, essentially to explain the purpose of the study to them. The students were given time to ask questions, to research the topics on their own and to comment on climate change and environmental sustainability issues that they considered important, which was intended to enable them to understand the significance of the study. This ensured that all the students understood what they had to do.

### **3.4.8 Surveys using questionnaires**

This study adopted the survey research design, which thrives on "interaction between a researcher and a potential respondent; a kind of conversation with a purpose" (Murphy, Hill & Dean, 2014:1). Surveys were deemed appropriate for the study mainly because they are "ideal for gathering information about population groups in educational settings to learn about their characteristics, opinions, attitudes or previous experiences" (Leedy & Ormrod, 2005:183). Besides, surveys provide quantitative descriptions of trends, attitudes, or opinions of the population studied (Creswell, 2014:234).

As survey studies are usually carried out by administering questionnaires and using the responses to the questions as data for the study (Fraenkel *et al.*, 2012:393), this type of instrument featured prominently in acquiring data for the study, particularly from the selected design students. The use of questionnaires was particularly useful for collating the insights of the students regarding their understanding of the abstract notions of environmental sustainability and climate change. Although questionnaires generally encounter low response rates (Ruane, 2005:124), this study

had almost every question answered by the study participants and the return rate was 100 per cent.

The questionnaire was administered via email as Google Forms while the students were preparing for the next session. They accessed the information on the mobile devices and laptop computers they were working on to accomplish this section of the gamified learning activities as part of their learning on the two concepts. They were aware that responding to the questions was a part of the day's activities and they had to post the completed forms before we went on break. Moreover, we had a stable internet connectivity and the enthusiasm and excitement the online activities and discussions had generated spurred the students to complete the survey to continue the remaining part of the gamified activities. Completing the survey and submitting them was seen as another level of the game and generated some competition and "high fives" as individuals and groups of them submitted their forms. The lively atmosphere in the learning space is the most plausible reason the questionnaire achieved a 100% return rate, with almost every questionnaire item answered by every student.

Two sets of questionnaires comprising 23 items each (see Appendix C) were designed to gather data from the study participants to address the guiding research questions. The questionnaires were specifically designed with open and closed-ended questions. Closed-ended questions have pre-determined response alternatives that the study respondent uses when answering the question (Cozby & Bates, 2012:134-135). Including closed-ended questions enabled the study participants to provide the required tangible answers on the two issues of climate change and environmental sustainability. The open-ended questions gave each respondent the opportunity to express their own opinions on the two issues in their own words (Cohen, Manion & Morrison, 2018:475-476). Furthermore, some sections of the questionnaire allowed the participants to fill in any gaps with their own thoughts and also make suggestions for improving the adoption of the findings.

As Mochizuki and Bryan (2015:12) explain, "people need a basic understanding of the causes (who, what and how) and the severity of the impacts of climate change (who is affected and how they are impacted by it), as well as the range of different mitigation and adaptation options which are available to enable them make informed decisions about the actions they need to take". Consequently, the questionnaire was designed to include questions on these different dimensions of the climate change issue. The survey was aimed at assessing the gaps in the students'

knowledge as a basis to inform the intended gamification application. The findings that I obtained from the survey questionnaire are presented in the form of tables and charts.

The first set of the 23-item questionnaire was administered to the Phase 1 group of seventy-five students before any structured activities took place, that is, prior to introducing gamification and its related activities in the design teaching and learning space in the selected HEI. This strategy was adopted to enable collection of the participants' own views on climate change and the environment before they utilised the gamification tools that aimed at inducing pro-environmental design behaviour among them. This made it possible for me to factor in the perceptions of the students regarding climate change and sustainability into the gamified learning system as well as to evaluate the impact of the gaming mechanics that were used.

The responses the Phase 1 group of 75 students gave to the questionnaire items provided insight to gaps in their knowledge about climate change and environmental sustainability that needed to be filled through the gamified learning activities in the design-led workshops. For example, not all the students answered every question as they were expected to. Some of the responses also indicated limited or lack of clear understanding of some of the survey items. There were also some mixed-up responses regarding the two concepts and how designers contribute to climate change. These mishaps prompted the need to review and modify some of the survey items to correct any ambiguities in the items and amend items that were not well defined, to improve the validity of the responses obtained (Bryman & Bell, 2015).

The modified version of the questionnaire was administered to the Phase 2 group of 90 students as part of the final day gamification workshop. The revision created opportunity for the second administration to yield enhanced responses from the 90 students at the end of the gamification workshop activities, mainly to assess the impact of the study. The Phase 2 responses to the questionnaire helped me to assess what the students had learned from the detailed discussions on climate change, environmental sustainability and how familiar graphic design tools can be used to promote environmental sustainability. This tool also enabled the students to demonstrate their understanding and learning regarding climate change and environmental sustainability.

Google Forms were used as a key tool to gather data that helped me to develop an understanding of how the graphic design students and their educators alike perceived the topic of climate change and sustainability, to know the level at which they were involved in climate change mitigation practices (if any) and to create an overall understanding of the design students' and their



educators' knowledge base on sustainability and climate change. Google Forms was also used to seek data on the students' knowledge of games, gamification, its tools, mechanics and possible applications. Feedback on the studio workshops and the digital games that were adopted for the gamified learning activities were also sought through the students' responses using Google Forms. Gender did not play any role in the selection of study participants or in analysing the responses that were obtained from the survey.

#### **3.4.9 Observation**

Observation allows a researcher to gather "first-hand, *live* data from naturally occurring social situations" (Wellington, 2015:247 in Cohen, Manion & Morrison, 2018; Creswell, 2012:13). Qualitative researchers may engage in roles that may vary from complete participant to non-participant while collecting data at the research site (Creswell & Creswell, 2018; Cohen, Manion & Morrison, 2018:542-545). Observation was used during the co-design workshops in the learning environment to have a better insight into the students' views on the environment and sustainable graphic design practice. Additionally, observation was used during the Question-and-Answer (Q & A) sessions on environmental sustainability, which formed part of the gamified learning experiences. Observation helped to better understand the graphic design students' perspectives on the environment and sustainable design practices.

In this study, both participant and non-participant observation (Creswell, 2014:239) were adopted. In the participant role, I acted as a facilitator for the various gamified activities. I facilitated class activities which employed gamified tools, and activities where the "normal" design procedures the students had used in tackling a problem were changed by applying some game mechanics. I also observed the group discussions with design thinking methods, the online search sessions and the day-to-day activities of the students as designers. In the non-participant observation situation, I observed the students during the design workshops and activities related to group design- thinking sessions where the students used "normal" design procedures in tackling a problem. I took field notes (Creswell & Creswell, 2018; Babbie, 2012) on the behaviour and activities of individuals at the research site.

#### **3.4.10 Photographs, audio and video documentation**

These visual-based tools (Gray & Malins, 2004:72) and activities were used to prompt discussions or recall events during the participatory design workshop activities. The gamification exercises

required participants to take photos, record audios and videos and to incorporate them as part of the sustainable graphic design projects they were working on. Secondly, these visual-based tools were a useful way of documenting data obtained from the workshops for the analysis and dissemination of research outputs.

#### **3.4.11 Design workshops**

Participatory design workshops were employed in this study to enable the collection of additional data to augment data that were harvested from the interviews, survey questionnaires and observations in the design-led workshops. In this study, three design-led workshop sessions were organised over two days and structured with game-based tools and mechanics, and design thinking strategies. The sessions were integrated into the normal two-hour class periods in the student-learning environment. This approach was adopted to have an overview of the viability of gamification in an ongoing design class. In all three workshops the students worked collaboratively in groups to develop ideas through brainstorming.

Design thinking strategies such as video, storytelling, illustrations and brainstorming (Seidel & Fixson, 2012:3; Debrah *et al.*, 2015:6), and other visual methods such as photographs and drawings (Creswell, 2018; Cohen, Manion & Morrison, 2018:628-636) were explored in the design workshops to gather the students' ideas on environmental sustainability. Storytelling was the vehicle for sharing ideas, describing and conveying views about climate issues in the students' local contexts as part of the learning process. It also served as a tool to describe concepts and perspectives on climate futures. These visual-based methods facilitated the brainstorming processes while the students worked in collaborative teams (Collins, 2010:29) to design and create artefacts that demonstrated their understanding of climate change and sustainability issues. Other visual-based methods such as co-design, photography, video and audio recording (Heather & Walters, 2016:40-42; Gray & Malins, 2004:72) were also employed to document the events and activities of the game-based learning workshops and the participating design students' ideas and experiences on environmental sustainability topics as part of the data gathering process. These resources served as a viable tool for discussion and ideation during the various phases of the design workshops.

Various game tools and mechanics were examined from hands-on interactions and brainstorming sessions through to free online gaming applications on environmental sustainability and climate change, which were all geared towards achieving the related behaviour adaptation and change.

In addition, free online gaming applications such as Quizzes, *Kahoot* and a modified version of *30 Seconds*, a South African board game, were explored in the workshops to enhance the sampled graphic design students' engagement with environmental sustainability towards inducing sustainable design practice among them. These gaming technologies were adopted for the gamified lessons in this non-gaming design education context to enhance the selected graphic design students' engagement with environmental sustainability towards inculcating sustainable design practice in them.

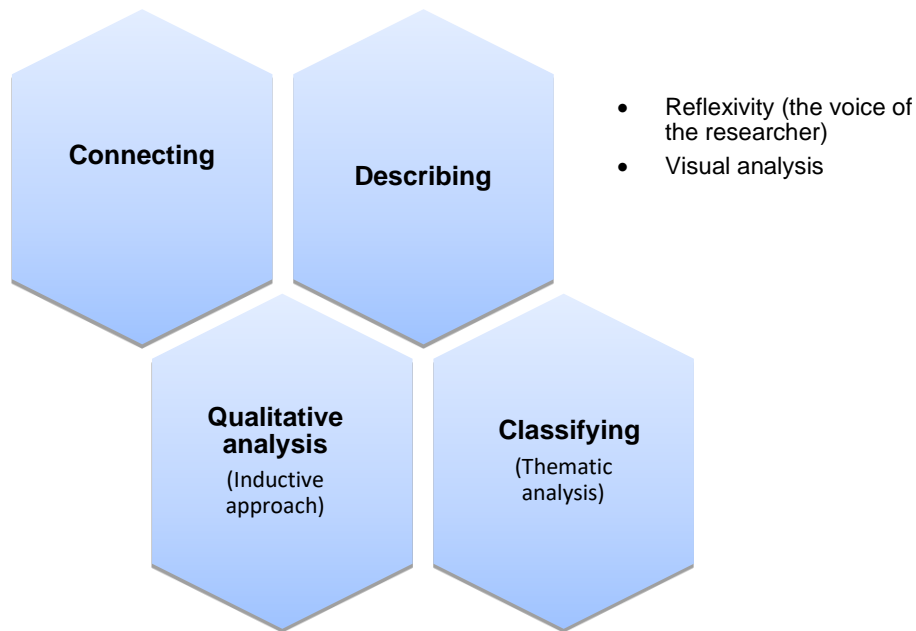
The students were required to take photographs, record audios and videos of the events, the learning activities and stories they told about their climate change experiences. They also created artefacts that incorporated the core values of environmental and sustainable design practices as part of the game-based learning experiences. This formed part of the sustainable graphic design projects the students worked on during the design activities on environmental sustainability as part of their learning from the gamification activities.

The design projects were meant to prompt discussions and/or recall of events during the participatory design workshop activities. The visual-based tools (Collins, 2010:150-151) that included text, videos, drawings, posters, videos and photographs were deemed useful in documenting the data obtained from the design workshops and the entire research process for analysis and dissemination of the research outputs.

The gamified workshop activities responded to the sub-research objective that sought to develop a gamification framework that could guide the teaching of environmental and sustainable design practices within the selected context.

### **3.4.12 Data analysis**

The term "data analysis" involves transforming data gathered into meaningful information that can be used in decision making (Kothari & Garg, 2014). It also describes the process of interpreting data and deducing meaning from them (Terrell, 2016). The inductive approach to qualitative data collection and analysis (Collins, 2010:92) was adopted in this study. Thematic analysis was done using Dey's (1993 cited in Gray, 2010:500) model illustrated in Figure 3.8, to examine both textual and visual data obtained. Thematic analysis is a method for finding repeated meanings or themes across a data set to guide the interpretation of the phenomena studied (Braun & Clarke, 2006, as cited in Lorelli *et al.*, 2017:2).



**Figure 3.7: Key areas in analysing qualitative data** (modelled after Dey, 1993 as cited in Gray, 2010:500)

The three *White Hat* gamification core drives, which are illustrated in Table 3.1, served as the framework to analyse the data obtained from the graphic design students' perspective on climate change and environmental sustainability. The data obtained from the study were classified to enable identification of the key areas and map the interrelations between the connecting themes (Gray, 2009:495–500). The data were then categorised using these three selected core drives in *White Hat* gamification which are: Epic meaning and calling; Development and accomplishment; Empowerment of creativity and feedback, to assess the study participants' designed artefacts on environmental sustainability.

The Octalysis framework also served as a guide to reveal emerging features of the gamified learning experiences from the participants' perspective (Chou, 2016:120). Thus, data obtained were analysed through an inductive approach while thematic analysis was employed to examine the textual and visual data derived from the study. However, in reporting the research findings, reflexivity (Gray, 2009:498) was used to describe the data obtained. Reflexivity in qualitative research work is “a process whereby researchers place themselves and their practices under scrutiny, acknowledging the ethical dilemmas that permeate the research process’ in order to make the politics of research transparent” (McGraw *et al.*, 2008:68 as cited in Mortari, 2015:1-2). Hence, reflexivity “turns the researchers’ lens back onto themselves to recognize and take

responsibility for their own situatedness within the research and for the effect that it may have on the setting, participants, questions asked, data collected and data interpretations” (Berger, 2015 cited in Finefter-Rosenbluh, 2017:2).

Reflexivity (the voice of the researcher approach) required that I reflect on my role in the study as an alumnus of the Graphic Design department. However, my experiences of students’ gaming culture in the university did not colour my interpretation of the themes and the meaning I deduced from the data I collected (Creswell & Creswell, 2018). This stance also required me to disclose how and why I arrived at the decisions I made to ensure trustworthiness of the findings (Tremblay *et al.*, 2021:3). Hence, as an insider of the research environment and not a neutral observer, my views and experiences contributed to the co-construction of knowledge represented in the study.

#### **3.4.13 Validity and reliability**

In research, *validity* refers to whether or not a data collection instrument measures what it is designed to measure. On the other hand, *reliability* refers to whether or not a data collection instrument shows consistency in measuring a phenomenon (Terrell, 2016:265,268). While validity and reliability are emphasised in quantitative research, qualitative research rather focuses on overall trustworthiness (Terrell, 2016). Qualitative validity implies the researcher employing certain procedures to check that the findings of the study are accurate whereas qualitative reliability implies that the researcher’s approach is consistently aligned with different researchers, and among other projects (Gibbs, 2007 as cited in Creswell & Creswell, 2018).

Thus, qualitative inquiry uses several data-gathering strategies to retrieve data from different sources for purposes of triangulation, describing the procedures adopted to gain entry to the research setting and securing permissions or the approval of the “gatekeepers” to study the participants or situation (Marshall & Rossman, 2016 as cited in Creswell & Creswell, 2018; Terrell, 2016). Giving detailed descriptions of the research context and presenting negative or contrary information also improves the credibility of an account. These were the steps that I followed to make the reporting of the study in this thesis trustworthy and credible.

#### **3.4.14 Ethical considerations**

Ethical considerations should be anticipated and extensively covered in research studies in order to protect their research participants, develop trust with them, guard against misconduct and

impropriety in order to promote the integrity of research (Creswell, 2014:132).. The graphic design students and their educators who participated in this study did so on voluntary basis. Permission was sought in order to respect the privacy of each individual as well as the visual data they would provide for the study (see Appendix A). This was done mainly because it is difficult to respect anonymity when qualitative data are represented by images of individuals and places (Creswell & Creswell, 2018; Cohen, Manion & Morrison, 2018).

### **3.4.15 Ethical issues relating to the study**

**Ethical considerations:** In line with social science and design research methods, I adhered to the necessary ethical issues relevant to this study. Hence, the following ethical principles (Gray, 2010:73–87) were followed to guide how the researcher approached the study participants:

- i. The informants were not forced into participating in the study.
- ii. Any informant who decided to pull out from the study and cancel the information delivered to the investigator was allowed to.
- iii. All information collected from participants were treated confidentially to avoid invasion of privacy and psychological harm except in situations where they were willing to share their information with the public.
- iv. Participants offered information namelessly.
- v. Names of the participants (or their design firms) were not part of the results as this could harm their status in the selected design community.
- vi. All participants were informed about the intended purpose of the study and what their contribution to the study would be.
- vii. The participant design educators will be provided with copies of the final outcome after the study to eradicate any wrong perception which might have occurred during the data collection processes.
- viii. Participants were not exposed to risk so the research methods were not reconsidered.
- ix. Informants were not coaxed into the research with incentives to participate in the study. Instead, the importance of the study was emphasised to encourage voluntary participation.

Additionally, the researcher adhered to the ethics and principles of the Faculty of Informatics and Design of CPUT as well as the fundamental principles of social science research. These included but were not limited to:

- i. Permission letters from all relevant organisations involved were obtained to maintain some of these ethical considerations in this study.
- ii. Data collection procedure and interpretation was void of bias as far as possible by using the appropriate methodology when conducting the study.
- iii. The results of the report have been communicated correctly without any bias.
- iv. It has been ensured that information obtained from the subjects will not be used in any adverse manner.
- v. The researcher has endeavoured to uphold the conventional and expected code of ethics, principles incorporating, among others, the guidelines of beneficence, respect for human dignity and justice.

### **3.5 Chapter summary**

This study mainly adopted design research methods to explore gamification or game-based learning as a pedagogical tool to extend climate change and environmental sustainability thinking to a purposive sample of one hundred and sixty-five third-year undergraduate graphic design students and their five educators in the Department of Graphic Design at the premier HEI of technology in Ghana.

The gamified learning experiences were designed as workshops that were modelled on three core drives from the *White Hat* gamification techniques of Yu-kai Chou's Octalysis framework. These are Epic meaning and calling; Development and accomplishment; Empowerment of creativity and feedback. This was informed by knowledge gaps that were identified in the survey by questionnaire responses provided by the first set of seventy-five design students who participated in the study. Various free online game-based tools and mechanics were explored in the participatory design workshops as part of the students' learning on environmental sustainability. The inductive approach was adopted to collect and analyse qualitative data and reflexivity was used in reporting the research findings. The details of the data gathered for the study are presented in the next section, which is Chapter Four.

## 4 CHAPTER FOUR: PRESENTATION OF THE FINDINGS

This chapter presents the findings regarding climate change and environmental sustainability, which were collected from the undergraduate graphic design students in the department of Graphic Design in the selected HEI of technology in Ghana. A 23-item questionnaire was designed to harvest the participating students' ideas for that purpose. The chapter also describes how design studio workshop activities were gamified to help the students learn about climate change and environmental sustainability in the context of the graphic design curriculum. In line with the view that gamification application does not involve creating a game (Subhash & Cudney, 2017:192; Landers, 2014:756), the presentation of the findings reflects game features that were harnessed to augment the existing graphic design learning process in the non-gaming context of higher education.

### 4.1 Gamification in design education

In order to make the teaching of environmental sustainability an accessible and fun activity, this study focused on the application of gaming elements in design education. The game-based learning approach was conducted through design-based research since it is human-centred to improve and facilitate behavioural change. The gaming concepts that were explored in this research study reflect the *mechanical*, *emotional* and *personal* levels of gaming illustrated in Figure 4.1. The gaming concepts that were utilised in designing the gamified learning experiences regarding environmental sustainability in the context of graphic design education were *Rapid feedback* (mechanical), *Flow* (emotional) and *Leaderboards* (personal).



**Figure 4.1: Gaming concepts** (Oxford Analytica Ltd, 2016:5)



Two case studies of game-based learning in higher education inspired and informed this study. Case study One (see Appendix B) was the integration of gaming mechanics in cloud computing courses at the Delft University of Technology, Netherlands. Game-design mechanics were used to increase students' engagement with the course and learning. Case study Two was a design futures course conducted in Tafari, Kenya. My team used gaming mechanics to propagate the concept of a sustainable solar energy system for the Tafari community members.

In this current study of gamification in design education, visual-based gaming elements were applied to enhance the design students' engagement with climate change matters as a strategy for encouraging behavioural change amongst them through a human-centred, design-based research approach. As part of their engagement with environmental sustainability, the graphic design students created artefacts that advocated sustainable futures during design workshops.

The following sections provide details of the gamification application data-gathering process that was adopted for the study.

## **4.2 The gamified learning investigation**

This study is situated within the context of graphic design education, a field that employs visual elements such as typography, images, colour, video and audio recordings to convey ideas and create artefacts, services and systems (Cristina *et al.*, 2015:141; Dritz, 2014; Yu & Sangiorgi, 2014:195–199). The field is steeped in practice, collaboration and experiential learning (Snaddon *et al.*, 2019:231; Motley, 2017:230; Dritz, 2014). As part of their engagement with environmental sustainability, the graphic design students designed visuals through design workshops and activities that advocated sustainable futures. All of the activities were situated within the gamification framework illustrated in Figure 4.2 in order to make the exercises a fun and enjoyable activity for the students and their educators.

A new set of game mechanics and activities were employed each day. Where any of the sessions exceeded the time allocated to the study on the department's timetable, that is, the two-hour lecture session, we ended the workshop and continued the activity the next day. This strategy helped to create a level of *progression* or a *level-up system*, which is a game mechanic in itself (Galbis-Córdova *et al.*, 2017; Lefers & Birkenkrahe, 2016). It also helped to assess the selected students' designed artefacts on environmental sustainability.

The gamified workshop activities responded to the sub-research objective that sought to develop a gamification framework that could guide the teaching of environmental and sustainable design practices within the selected context. The following sections provide the details of the process.

#### **4.2.1 The game starts: Level One, Day One, Session One activities**

##### **4.2.1.1 Climate change and the environment**

The day's session of the gamified learning experiences was devoted to assessing the participating students' knowledge on climate change and environmental sustainability as foundation data to inform the gamified learning activities. The aim was to encourage them to engage with the concepts of climate change in relation to design thinking and practice that supports environmental sustainability.

This session began with a one-hour question-and-answer interaction that covered a range of selected topics on climate change and environmental sustainability. The topics focused on the concept of climate change, climate change effects seen in Ghana, climate change and the natural environment, environmental sustainability, how the graphic design industry contributes to climate change and how design is being used to promote environmental sustainability. In order to make the subject come alive for the students, we analysed the local graphic design industry and explored possible ways in which the industry is contributing to climate change.

The learning experiences elicited conversations that made reference to events like droughts, floods and wildfires, which are becoming more extreme in recent times (Kayaga *et al.*, 2020:4; Vardoulakis *et al.*, 2015:307). Google images and videos were downloaded and discussed to draw the students' attention to environmental concerns in Ghana and other parts of the world due to negative human activities. The question-and-answer session also engaged the students to reflect on their shared experiences or readings about climate change.

In particular, we talked about how the adverse effects of climatic conditions on the environment over a period of time could affect national security in parts of the world (Barnett & Adger, 2007:639–655; Connolly-Boutin & Smit, 2016:389). An example that materialised during the discussion concerned media reports on herdsmen who had migrated from the dry Sahelian regions of West Africa and were grazing their cattle on food crops, leading to armed conflicts in various communities in the Eastern and Ashanti Regions of Ghana. We discussed the security

breaches to life and property in those communities until the government of Ghana set up “Operation cow leg”, which involved joint military and police teams that were dispatched to both protect the people and the food crops, as well as flush out the herdsmen and their cattle. This scenario brought home to us the real cost of climate change and the urgent need to sustain the environment to prevent desertification and the risk of food insecurity and conflict over natural resources, particularly in Africa (Connolly-Boutin & Smit, 2016; Pisano et al., 2015).

The fundamental notion I emphasised at this point was the idea of climate change as “a complex social and scientific phenomenon” (Nelson *et al.*, 2007:397; Hu & Chen, 2016:3) that is difficult to communicate in appropriate messages (Whitmee *et al.*, 2015:1973-1974; Boon, 2016:1009). A few of the students described lessons they were taught about climate change in social studies and integrated science while they were in senior high school. Some of the students reported finding those lessons very difficult to understand and relate to. Some students who resided in the northern parts of Ghana said the descriptions offered by their teachers were familiar living conditions so they understood what they were taught about variable weather conditions and related issues that the teachers based their lessons on. This discussion was reinforced by the notion that Ghana has different ecological and climatic zones that range from coastal savannah to the humid rainforests in the middle and the dry, hot Sahel in the north of the country (Kayaga *et al.*, 2020:4; Ministry of Foreign Affairs (MoFA), 2018:3).

## **LEVEL 2: Day One Session One Activities**

### **4.2.2 Graphic design and the environment**

Considering the changes that the world has experienced regarding climate change impacts, in particular, the discussion touched on the negative effects of artefacts such as packaging, which the design industry produces using plastic, metal and other materials that are not biodegradable and end up as waste polluting the environment. The discussion focused on sanitation and other environmental concerns encountered in Ghana due mostly to plastic waste that is commonly seen on roadsides and in open drains in some local communities. The discussion made it obvious why the world is blaming the graphic design industry for contributing to environmental pollution on a large scale (Yu & Sangiorgi, 2014:195-199; Grönman *et al.*, 2013:187–189; Manzini, 2007:3). Online images that were used as reference points to illustrate this discussion include what is shown in Figures 4.2 and 4.3.



**Figure 4.2: Packaging waste material** (Google images)



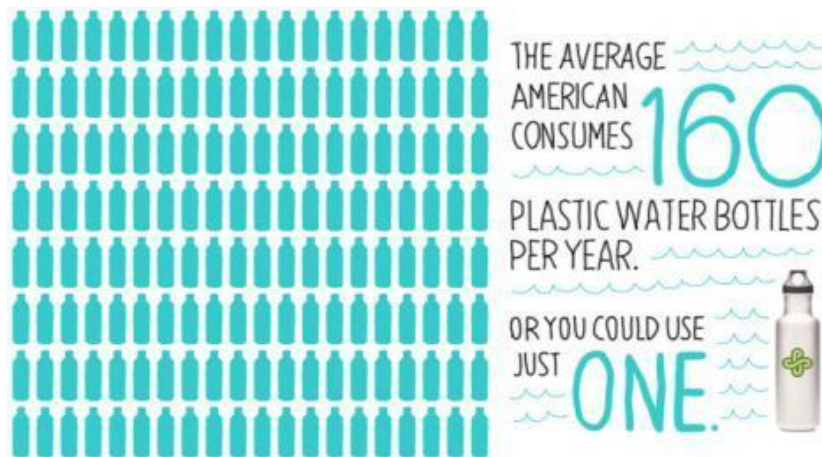
**Figure 4.3: Packaging waste materials** (Google images)

From this position, the discussion turned to the positive side of graphic design as an industry that is able to re-think the design process to create new sustainable solutions (Manzini, 2007:3; Park, 2004:4-5). This enabled the students to appreciate graphic design as a suitable tool for advocating difficult concepts such as climate change to the public in different formats (Cristina *et al.*, 2015:141-142). The discussion enabled understanding of the role of text, images and other visual-based tools in breaking complex information into simple messages that ordinary people can understand and act upon (Geise & Baden, 2015:49). An example that was used to support this conversation is shown in Figure 4.4, which shows different water branding designs that make use of the visual language of image and text in the packaging.



**Figure 4.4: Packaging and water branding** (Google images)

Sustainable advertising messages on water conservation and re-use of the water bottles are also conveyed through the packaging and branding design as seen in Figure 4.5.



**Figure 4.5: A sustainable advert using graphic design tools** (Google images)

The important consideration here was inducing the students to appreciate graphic design as a unique tool for promoting environmental sustainability and sustainable living.

### **LEVEL 3: Day One Session One Activities**

#### **4.2.3 Graphic design and sustainability**

At this point, the discussion shifted to the use of graphic design as an advocacy tool for promoting sustainable ways of living. The example used was the research study conducted by Whitehair *et*

al. (2013) that focused on reducing food waste among students at a Finnish university using two types of graphic design messages on *food waste* as seen from the illustration in Figure 4.6.



**Figure 4.6: Graphic design messages on food sustainability and the environment** (Whitehair *et al.*, 2013:65)

The discussion showed that simply responding to printed messages on food waste motivated the university students who participated in this experiment to take action to live more sustainably. The students' action reduced food waste and led to improved food services on their campus (Whitehair *et al.*, 2013:65-68).

In addition, examples of images of graphic design products that use visual language to design sustainable messages on packages were examined and discussed and are included in Figures 4.7 and 4.8.



**Figure 4.7: An example of sustainable ways of living using graphic design messages** (Google images)



**Figure 4.8: Advertisements on sustainable ways of using fuel and water** (Google images)

All these examples enabled me to show the participating students how simple graphic design messages can be used to communicate and promote sustainable ways of living. These interactions were situated within the gamification framework to create fun and make the learning enjoyable for the students and their educators. This aspect of the investigation was very interactive and emphasised how graphic design contributes to environmental degradation and can also serve as a powerful tool for mediating communication on climate change and promoting sustainability via its visual formats to present difficult concepts in messages that people can understand and act upon.

## Day One Session One activities

### 4.3 Phase 1: Survey findings

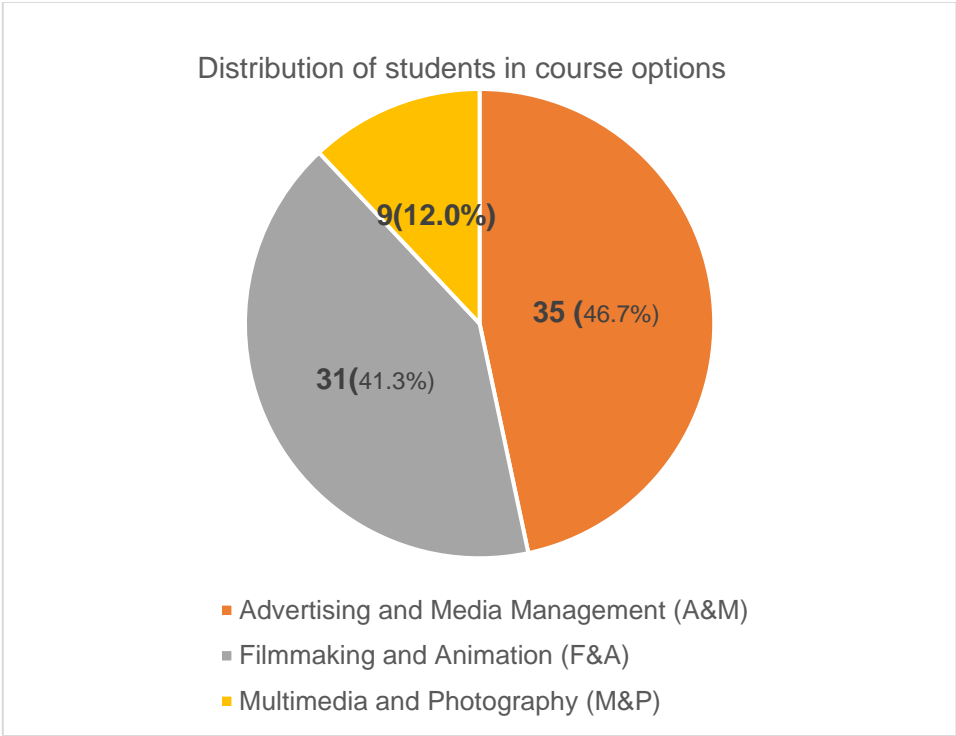
To demonstrate their understanding and learning on climate change and environmental sustainability, this Phase 1 group of 75 students were asked to answer the purposely designed 23-item questionnaire to enable me to assess what they had learned from the discussions on climate change and environmental sustainability, and how the familiar graphic design tools could be used to promote environmental sustainability. The survey questionnaire was aimed at assessing the gaps in the students' knowledge as a basis to inform the proposed gamification application.

The 23-item questionnaire was divided into four sections. Section A dealt with the research context; Section B focused on climate change and environmental sustainability; Section C required details on the medium that provided the students with information on climate change and sustainability; and Section D invited information on the students' interest in climate change and environmental sustainability issues. The forthcoming section of this chapter reflects the survey responses that the Phase 1 group of 75 students provided. The presentation has been illustrated with frequency tables and pie charts.

**4.3.1 The research context**

**4.3.1.1 Study participants**

There were 75 students in this Phase 1 group of study participants, namely, 75 undergraduate graphic design students in their third year of the four-year Communication Design programme. The survey responses showed they were majoring in three programme options: Advertising and Media Management, Filmmaking and Animation, and Multimedia and Photography. Sixty-six (representing 88.0%) of the 75 were in Advertising and Multimedia and nine (or 12.0%) in filmmaking. The details are shown in Figure 4.9.



**Figure 4.9: Distribution of participants on course options**



### 4.3.1.2 The students' design experience

The survey revealed that the 75 study participants had engaged in design for a minimum of two (2) years and a maximum of 10 years. The majority (34, representing 45.3%) of them reported three (3) years of field design experience followed by 13 or 17.5 per cent who reported six (6) years. The details regarding the range of design experience of the 75 study participants are shown in Figure 4.10.

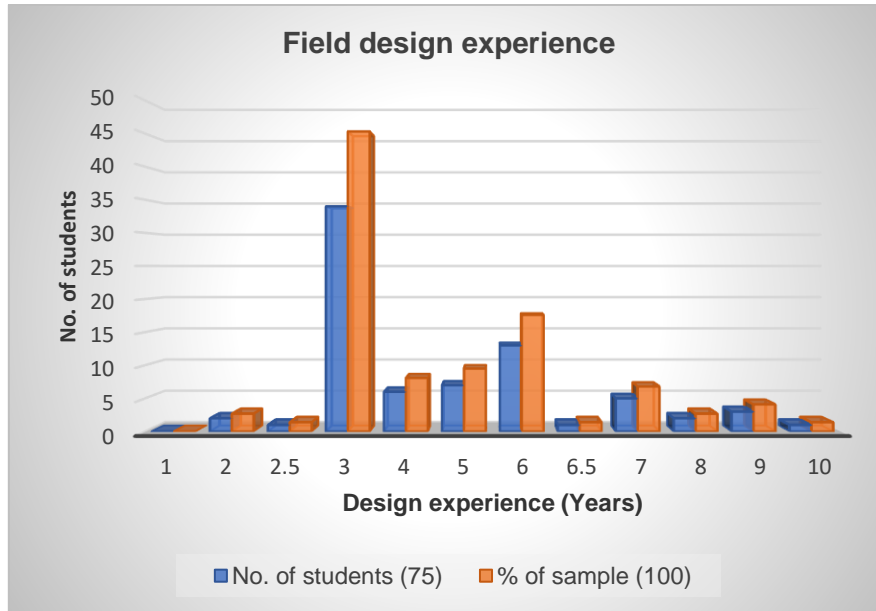


Figure 4.10: Years of design experience

### 4.3.2 Familiarity with climate change and environmental sustainability

This section of the presentation of the results provides data regarding the study participants' awareness and understanding of the two concepts of climate change (CC) and environmental sustainability (ES). This theme includes how the participants understood the two concepts in addition to the aspects of sustainability they were familiar with.

#### 4.3.2.1 Knowledge about CC and ES

The survey sought to understand how much the study participants knew about climate change and environmental sustainability. Overall, 19 (representing 25.3%) of the 75 participants provided responses that did not relate to the two concepts as expected. Another set of 17 (or 22.7%)

responses simply stated knowledge of the two concepts as “basic”, “a lot”, “not very much”, among others. In effect, 39 (forming 52.0%) of the responses expressed knowledge that reflected the literature on both concepts. The details of these responses are shown in Table 4.1.

**Table 4.1: Knowledge expressed about CC and ES**

	<b>No. of Students</b>	<b>% of Total</b>
CC only, inadequate	14	18.7
ES only, inadequate	7	9.3
CC and ES, valid	5	6.7
CC and ES, literature specific	13	17.3
CC and ES, vague	17	22.7
CC and ES, unrelated	19	25.3
<b>Total</b>	<b>75</b>	<b>100.0</b>

The students’ knowledge of climate change was expressed in terms of “changes in the earth’s temperature”, “weather conditions and patterns”, “rising levels of carbon dioxide”, “climate conditions”, among the 18 valid responses about climate change. Knowledge about environmental sustainability identified in the same batch of 18 valid responses described the concept in terms of “protecting our environment for the future”, “maintaining our environment”, “managing the natural resources for future generations” and “responsible interaction with the environment to manage the natural resources”.

#### **4.3.2.2 Familiar aspects of environmental sustainability**

This question was meant to find out specific aspects of environmental sustainability that the study participants were familiar with. The responses that were recorded were as follows:

1. Forty-nine (or 65.3%) of the responses recorded in the survey provided definitions of sustainability.
2. The remaining 26 (or 34.7%) responses cited *afforestation* and *waste recycling* as aspects of environmental sustainability they were familiar with.
3. Participants who identified *afforestation* equalled 20 and represented 26.7 per cent of the selected 75 students.

4. Those who cited *waste recycling* totalled seven (7) and formed 9.3 per cent of the 75 study participants.

### 4.3.3 Sources of information on climate change and environmental sustainability

This thematic area of the survey was meant to identify all the sources from which the study participants learned about the two concepts of climate change and environmental sustainability. One participant did not respond to this item, which required the students to tick all the response options that applied in their case.

The option of television/radio/newspapers/internet, as a source of climate change and environmental sustainability information was selected by 69 (representing 93.2%) of the 74 students who responded to this survey item. The sources from which the respondents in the study learned about the two phenomena are provided in Table 4.2.

**Table 4.2: Participants' sources of CC and ES information**

	<b>N=74</b>	<b>Percent</b>
School/college/university Government agencies/information/ Public libraries	5	6.8
Television/Radio/Newspaper/Internet/Friends and Family	20	27.0
Television/ Radio/ Newspaper/ Internet/ School/ college/ university Government agencies/information/Public libraries	25	33.8
Television/ Radio/ Newspaper/ Internet/ Specialist publications/ academic journals/ Environmental groups (e.g., Wildlife Ghana)	24	32.4
<b>Total</b>	<b>74</b>	<b>100.0</b>

#### 4.3.4 Interest in climate change issues

This section of the questionnaire sought information on the students' interest in climate change issues and how much attention they had given to discussions on the phenomenon. This includes the importance, causes, effects and impacts of CC on the global and local environments.

##### 4.3.4.1 Importance of climate change

To determine how the study participants perceived the climate change phenomenon, they were asked to rate its importance against three expected responses (see Table 4.3). Only 10 (representing 13.5%) of the 74 participants who provided answers to this item rated CC as *very important*. Details of the responses are shown in Table 4.3.

**Table 4.3: Importance of climate change issues**

	N=74	%
Very important	10	13.5
Quite important	33	44.6
Not very important	31	41.9
<b>Total</b>	<b>74</b>	<b>100.0</b>

##### 4.3.4.2 Causes of climate change

This survey item sought to know the study participants' views on the possible factors that cause climate change. Those who cited *human activities* totalled 48 and formed 64.0 per cent of the 75 study participants. The related responses that were given to this item are shown in Table 4.4.

**Table 4.4: Causes of climate change**

<b>Factor</b>	<b>Frequency</b>	<b>Percent</b>
Pollution	6	8.0
Human activities	48	64.0
Natural occurrence	21	28.0
<b>Total</b>	<b>75</b>	<b>100.0</b>

#### 4.3.4.3 Climate change impacts on the environment

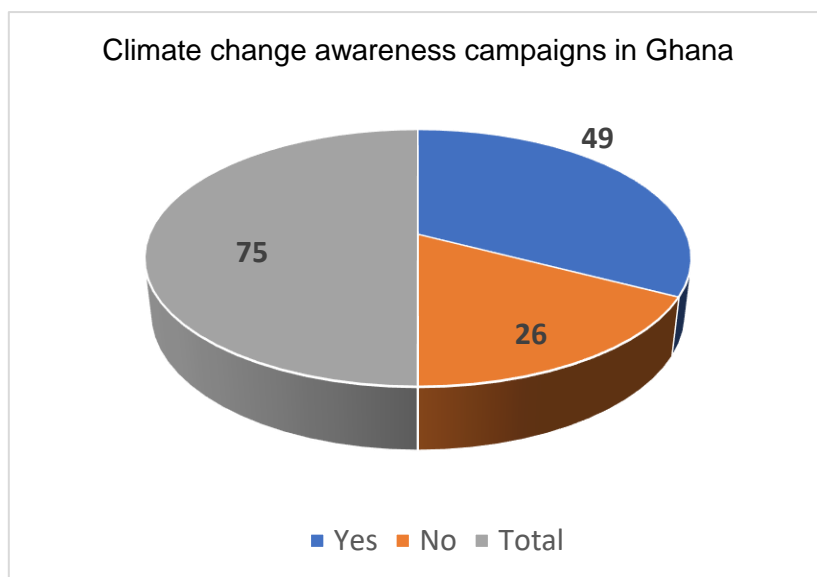
This survey item sought to find out what the study participants perceived as the ways in which climate change may affect the natural environment. Seventeen (representing 22.7%) of the responses given by the 75 participants who responded to this survey item did not relate to the two concepts. The remaining 55 (forming 73.3%) responses expressed limited ideas on the causes of climate change, its effects and impacts on the environment. The literature-related factors were the following:

- Deforestation (14 responses)
- Pollution due to human activities (13 responses)
- Rising temperatures and extreme weather conditions (11 responses)
- Climate change impacts such as drought, flooding and associated health implications (17).

There were two other design-related responses that cited “excessive use of ink”. A single response stated, “climate change is only a threat; it cannot harm the environment”.

#### 4.3.4.4 Climate change awareness campaigns in Ghana

This question aimed to find out whether the study participants had observed any climate change awareness campaigns being carried out in Ghana. The 75 study participants who responded to this survey item provided 49 Yes responses. The detailed responses are shown in Figure 4.11.



**Figure 4.11: Climate change awareness campaigns in Ghana**

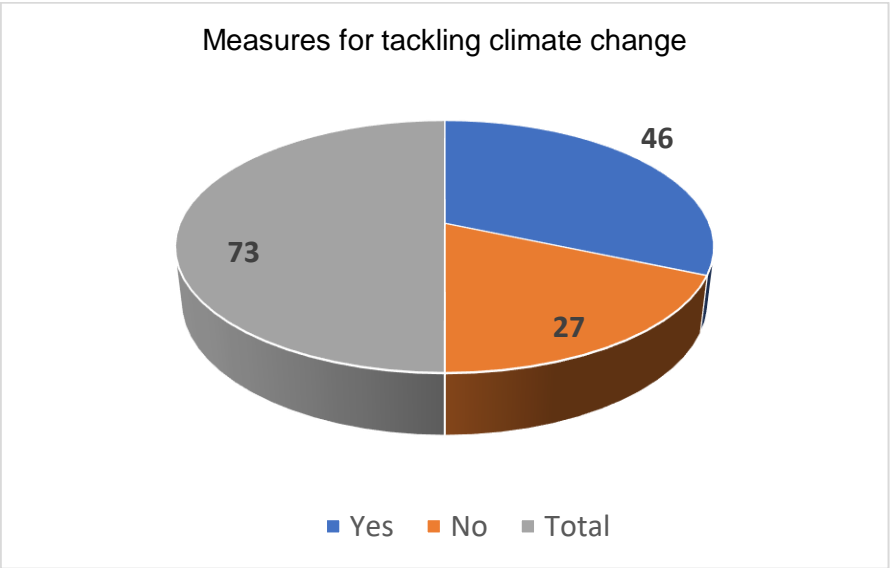
In the study, climate change awareness campaigns in the HEI recorded 52 (representing 66.7%) *No* responses from the 72 study participants who responded to this survey item. The different responses are shown in Table 4.5.

**Table 4.5: Climate change awareness campaigns in the HEI**

	<b>N=72</b>	<b>Percent</b>
Yes	12	16.7
No	48	66.7
Not enough	4	5.6
Not sure	8	11.0
<b>Total</b>	<b>72</b>	<b>100.0</b>

**4.3.4.5 Measures for tackling climate change**

This survey question sought to find out if the students had any idea of actions or measures that could be adopted to deal with the climate change phenomenon. Those who responded *Yes* totalled 46 and formed 63.0 per cent of the 73 study participants who answered the question. The remaining 27 responses rather defined the actions to be taken as shown in Figure 4.12.



**Figure 4.12: Measures for tackling climate change**

#### 4.3.4.6 Schools teach about climate change

On whether schools in Ghana teach their students about climate change, 40 (representing 55.6%) of the 72 study participants who answered this survey item said Yes. The other responses are shown in Figure 4.13.

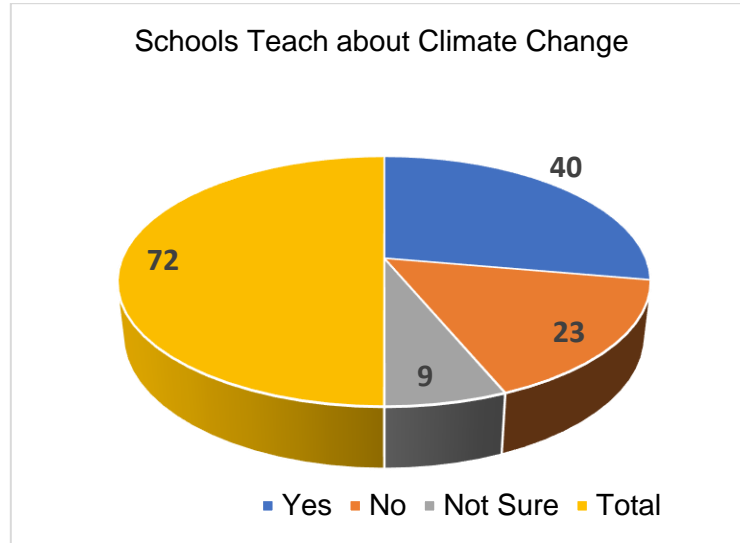


Figure 4.13: Schools teach about climate change

#### 4.3.4.7 I was taught about climate change

On whether the study participants were taught about climate change in the high schools they attended before they enrolled in this HEI of technology, 30 or 44.1 per cent of the 75 study participants said Yes as shown in Figure 4.14.

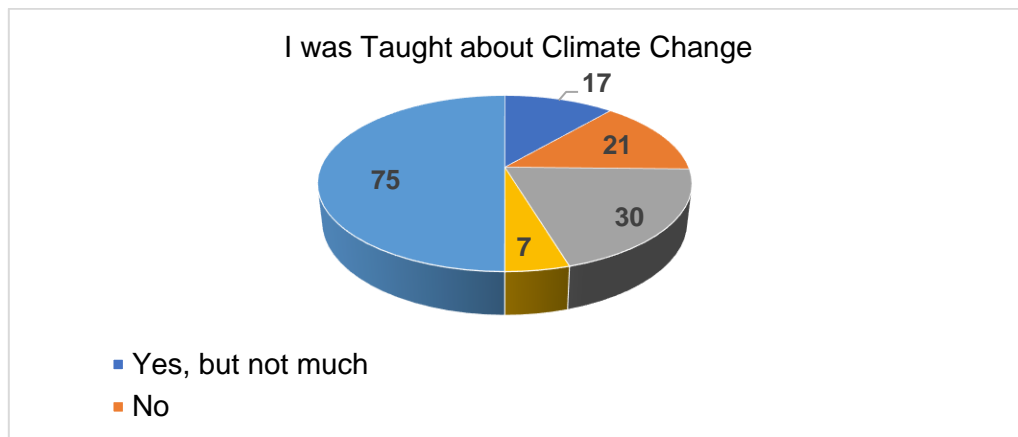


Figure 4.14: I was taught about climate change

#### 4.3.4.8 The meaning of climate change

This survey item sought to find out what climate change meant to the study participants. They needed to select all the options of expected responses that best defined their understanding of the phenomenon. The majority (60 or 22.7%) of the 264 multiple responses identified climate change as “change in weather condition” as compared to 45 or 17.1 per cent of the responses that defined the concepts in terms of “change in environment”. The other meanings of climate change are shown in Table 4.6.

**Table 4.6. The meaning of climate change (multiple responses)**

	<b>N=75</b>	<b>Percent</b>
Change in climate due to global warming	57	21.6
Change in climate due to human pollution	51	19.3
Change in temperature	51	19.3
Change in environment	45	17.1
Change in weather condition	60	22.7
<b>Total responses</b>	<b>264</b>	<b>100.0</b>

#### 4.3.4.9 Climate change impacts on the environment

This question sought the study participants’ knowledge about different impacts of climate change on the global environment. They indicated this by ticking options from expected responses. *Flooding and sea level rise* recorded 40 responses each as compared to *global warming* with 64 or 21.3 per cent of the total (300) responses. The details of the responses are shown in Table 4.7.

**Table 4.7 Climate change impacts on the environment**

	<b>N</b>	<b>Percent</b>
Drought	47	15.7
Flooding	40	13.3
Global warming	64	21.3
Rising temperature	62	20.7
Sea level rise	40	13.3
Increasing intensity and frequency of extreme weather events	47	15.7
<b>Total responses</b>	<b>300</b>	<b>100.0</b>



#### 4.3.4.10 Climate change impacts that will affect Ghana

This survey item sought to know from the study participants, which of the climate change impacts listed in the previous item would affect the local environment in Ghana. *Global warming* recorded the most (30 or 30.0%) responses as compared to *sea level rise* which recorded seven (7 or 7.0%). Other responses are provided in Table 4.8.

**Table 4.8 Climate change consequences that will affect Ghana (multiple responses)**

	<b>N=75</b>	<b>Percent</b>
Drought	16	16.0
Flooding	13	13.0
Global warming	30	30.0
Rising Temperature	26	26.0
Sea level rise	7	7.0
Increasing intensity and frequency of extreme weather events	8	8.8
<b>Total responses</b>	<b>100</b>	<b>100.0</b>

#### 4.3.4.11 Entities in Ghana climate change will mostly affect

This question sought to know who the 75 study participants believed will be mostly affected by climate change consequences. Seven (7) of the participants gave two ideas each, which resulted in a total of 82 responses. The majority (65 or 79.3%) of the total responses revealed that *every person* and *living organism* in Ghana will be mostly affected by climate change consequences. The other responses are shown in Table 4.9.

**Table 4.9 Entities in Ghana climate change will mostly affect**

	<b>N=82</b>	<b>Percent</b>
The economy	7	8.5
Everyone in the society	51	62.2
All living organisms	14	17.1
The environment	10	12.2
<b>Total</b>	<b>82</b>	<b>100.0</b>

#### 4.3.4.12 Personal changes to minimise climate change effects (multiple responses)

This survey item sought to understand personal changes the 75 study participants were willing to make, as designers, to increase their preparedness to minimise the effects of climate change. The only personal response stated among those given by the 66 study participants who answered this survey item was “changing my attitude to the environment”. This response was given by 14 of the participants and formed 16.8 per cent of the total responses. The other responses that were given are shown in Table 4.10.

**Table 4.10: Personal changes to increase preparedness to minimise climate change effects**

	<b>N=66</b>	<b>Percent</b>
Create awareness about CC	20	23.8
Join a campaign team	16	19.0
Use design for education	18	21.4
Educate others	16	19.0
Change my attitude to the environment	14	16.8
<b>Total</b>	<b>84</b>	<b>100.0</b>

#### 4.3.5 How designers contribute to climate change and sustainability

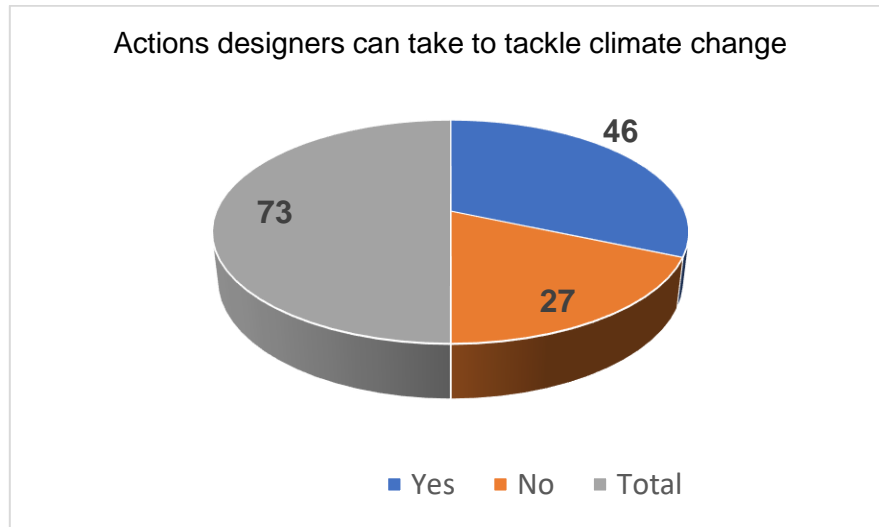
This survey item sought to know the study participants’ views on how designers and design practices contribute to the climate change menace and the promotion of environmental sustainability. How the 73 study participants who responded to this item answered the question is shown in Table 4.11.

**Table 4.11: How designers contribute to CC**

	<b>N</b>	<b>Percent</b>
Design motion graphics to create awareness	33	45.2
Design motion graphics to educate people	13	17.8
Campaigning	10	13.7
Creating medium of communication	9	12.3
Innovation	8	11.0
<b>Total</b>	<b>73</b>	<b>100.0</b>

#### 4.3.5.1 There are actions designers can take to tackle climate change

This question sought to know if the study participants were aware of any measures or actions that designers can adopt to deal with climate change. There were 73 total responses, of which 27 stated *No* and 46 responded *Yes* as shown in Figure 4.15.



**Figure 4.15: Actions Designers can take to tackle CC**

#### 4.3.5.2 How designers can help curb climate change

This question sought to know the students' views on how the practice of design promotes climate change and sustains the environment. The 73 students who responded to the question answered it as shown in Table 4.12.

**Table 4.12: How designers can help to curb CC**

	<b>N</b>	<b>Percent</b>
Create commercial adverts on CC	33	45.2
Design motion graphics to educate people	13	17.8
Adopt unified CC advocacy campaigning	10	13.7
Learn about CC and ES	9	12.3
Raise awareness about the environment	8	11.0
<b>Total</b>	<b>73</b>	<b>100.0</b>

#### 4.3.5.3 Suggested ways designers can help to sustain the environment

There are several ways by which designers can help to sustain the environment. These are shown in Table 4.13.

**Table 4.13: Suggested ways designers can help to sustain the environment**

	<b>N</b>	<b>Percent</b>
Design motion graphics to create awareness	33	45.2
Educate designers on CC causes and effects	13	17.8
Unified campaigns	10	13.7
Create commercials for public communication	9	12.3
Innovation	8	11.0
<b>Total</b>	<b>73</b>	<b>100.0</b>

#### 4.3.6 Phase 1 survey findings summary

The findings presented here show that not all the Phase 1 group of 75 students responded to the survey items. Furthermore, not all of them responded to all the survey items posed on the concepts of climate change and environmental sustainability as expected. It is seen from the findings that the students had limited knowledge about climate change and not all of them (60.0%) reported being taught about the phenomenon in high school.

The 75 students generally understood environmental sustainability in terms of preserving the natural resources available to humanity on Earth. Twenty-five (or 33.3%) of the respondents identified afforestation and waste recycling as the aspects they were familiar with. Essentially, only five (or 6.8%) of this Phase 1 group of 75 students had learned about climate change and environmental sustainability from public agencies such as schools, libraries and the Information Services department of the Ministry of Communication in Ghana. Some of the students recognised climate change as an important issue. Those who reported that climate change awareness campaigns were occurring in Ghana was confirmed by 64.0 per cent of 72 participants while conversely, 66.7 per cent of them denied this was happening in the HEI.

The students recognised *global warming* and *rising temperatures* as climate change effects on the environment. As many as 55 (or 73.3%) of the participants expressed awareness that “climate change has some impact on environmental sustainability”. They all (100%) agreed that everyone in Ghana, including plants and animals, were at risk of climate change impacts. However, the responses revealed “change of attitude to the environment” as the main personal action the participants were willing to take to increase their preparedness to minimise the effects of climate change, especially as designers. The questionnaire results revealed that only a minority (8.0%) of the students understood how the output of designers and the design industry in general, contribute to climate change. Overall, 37 per cent of them recognised design as a tool that can be used in public education, for example, to promote environmental sustainability. These data therefore provided a justification to adopt game-based learning strategies to extend the concepts of climate change and environmental sustainability to the selected graphic design students in this HEI of technology in Ghana.

#### **LEVEL 4: Day One, Session Two activities**

##### **4.4 The design workshops**

Three design-led workshops based on design thinking methods of observation, collaboration and prototyping, gamification, game-based mechanics and participatory research formed part of the study. As instructional methods, this form of mediated learning was used to shed additional light on the possibilities of designing an innovative framework for using design tools to interrogate climate change, environmental sustainability and student engagement issues as applicably as possible. The relationship between design thinking and participatory design methods were discussed as the primary driving forces here, supported by the game-based mechanics chosen for the sessions.

The learning activities were characterised by active presentations of projects. These projects focused on identifying problems in society which could be solved through design to effect change in society. Lessons on sustainability were introduced as part of the semester activities to provide learners with a desirable foundation to design sustainably. These lessons were structured in two modalities using an experiential learning approach (Jose *et al.*, 2017:270-271). The design studio activities were designed to build on the survey findings to enhance the sustainability projects the students would create.

#### **4.4.1 Brainstorming climate change and sustainability concepts**

To start with, the students were organised into random groups to enable them to discuss what they knew about climate change and sustainability, to define what each term meant to them as design students and to brainstorm possible solutions to climate change and sustainability effects they would identify from pictures, online videos shown to them and storytelling about their own personal experiences of climate change. They were given large sheets of manilla card on which to document their shared views as teams on climate change and environmental sustainability. Each discussion group also received a different set of coloured markers to identify, designate and represent the respective groups in order to make it easy to differentiate between these groups. To this end, the students worked on projects that incorporated the core values of environmental and sustainable design practice to demonstrate what they had learned about the use of graphic design to promote environmental sustainability.

In line with the practice of design, the students worked in collaborative teams (Snaddon *et al.*, 2019; Motley, 2017; Debrah *et al.*, 2016; Dritz, 2014; Chisin *et al.*, 2014) to design and create artefacts that demonstrated their understanding of climate change and sustainability issues. They used graphic design tools such as mind mapping and design thinking strategies to respond to specific tasks. The tasks also engaged the students in discussions on climate change and sustainability issues while mind mapping their responses. At the end of the sessions, the students had the option to develop contextualised advertising campaigns or a form of a medium of communication using their preferred unique graphic design tools such as text, drawing, audio and video recordings.

#### **4.4.2 Games the students play**

This layer of the Level 4 activities of the gamified learning was used to focus the students' attention on physical and digital games they usually play. The purpose was to introduce them to the concept of game-based learning and to prepare them for the next day's core design workshop activities. I guided the students to interrogate the concept of games, the kinds of games they usually play, why they play those particular games, the equipment or devices that are involved in playing those games, who they play those games with and whether they would appreciate the use of games by their educators as part of their design learning.

After five minutes of this whole-class interaction, the students dispersed to work as groups to brainstorm on a 12-item open-ended, short answer questionnaire (see Appendix D) that focused on games. They had to discuss each question as a group, have individuals supply their answers, record each one and finally tally the different answers to generate a report that summed up and documented their collective ideas by eliminating repeated items such as the names of games. This was a very exciting event with many “high-five” hugs and handshakes when two or more students discovered they shared common favourite games and reasons for playing the listed games. The session ended with a reflection on the day’s activities and an explanation of what the students should expect in the next day’s design workshop.

#### **LEVEL 4: Day Two Session One activities**

##### **4.4.3 Brainstorming games and gaming**

Discussion of the digital games and related information the students had provided through the 12-item questionnaire defined the types of games and devices they play the identified games on (see Appendix D). The only physical game that emerged from the interaction on the variety of games was *Ampe*, a jumping, clapping and counting game that is typically played by women and girls in Ghana. The outlined digital games, which Kapp *et al.* (2020) describe as “commercial casual games” include the following listed games:

1. Colour switch
2. Far cry
3. PES 17
4. Brick breaker
5. FIFA 16
6. Subway bike blast
7. Subway surfers
8. Candy crush

The devices the students cited they play the identified games with, included laptop computers, mobile phones, PlayStations and gaming consoles. The reasons listed for playing the identified games include fun, relief of stress or boredom, entertainment, adventure and intellectual stimulation. Listed among the elements the students liked about their favourite games were the graphics, story lines, sounds and game concepts. All 90 students would appreciate their educators

using games to teach because that would motivate them to develop creative design ideas. This information provided the opportunity for me to talk briefly about gamification and the objectives of this study.

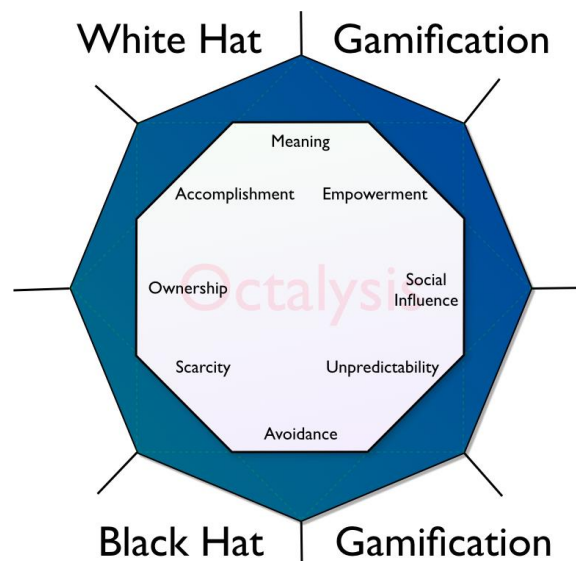
#### **4.4.4 Promoting environmental sustainability through gamification**

This section provides a description of the gamified learning activities using the Octalysis framework. The foundation for this session was the recap of the second layer discussion on games the students usually play as described earlier in Section 4.4.2. From this point, I shifted the conversation to application of gamification in education, what the term means, how the term evolved and areas where the concept is being applied that included commerce and the field of education. For added value, I had the students go online to search for literature on gamification and compile notes on the variety of meanings and applications of the concept. The search sparked animated conversations on experiences of different kinds of gamification applications and associated rewards they had encountered previously but did not know them as gamification tools. Mention was made of toys and prizes that they or other people they knew had won as loyalty tokens from McDonald's, Burger King, Disney World and some supermarkets in Europe, USA, as well as Nestlé and other companies in Ghana, for example. Some instances touched on discounted products the individuals or their parents and friends had earned in exchange for loyalty coupons.

References were also made to *stars*, *stickers* and *badges* some of the students had been awarded in school which bordered on gamified learning. Some mentioned the *achievement stars*, *stickers* and *badges* they had earned in primary school for doing well in class assignments and tests. These gaming concepts were discussed in relation to *Pokémon games*, *Angry Birds*, *Kahoot* and the *30 Seconds* South African board game with respect to their advantages to learning in educational contexts.

When the excitement was high, I quickly veered the conversation to the main topic of gamification by projecting Yu-Kai Chou's Octalysis framework onto the whiteboard. I used that to explain the various points of the octagon that represent the core drives of *White hat* and *Black hat* gamification and how they reflect game play experiences. Interactions at this stage were based on the illustration of the Octalysis model in Figure 4.16.

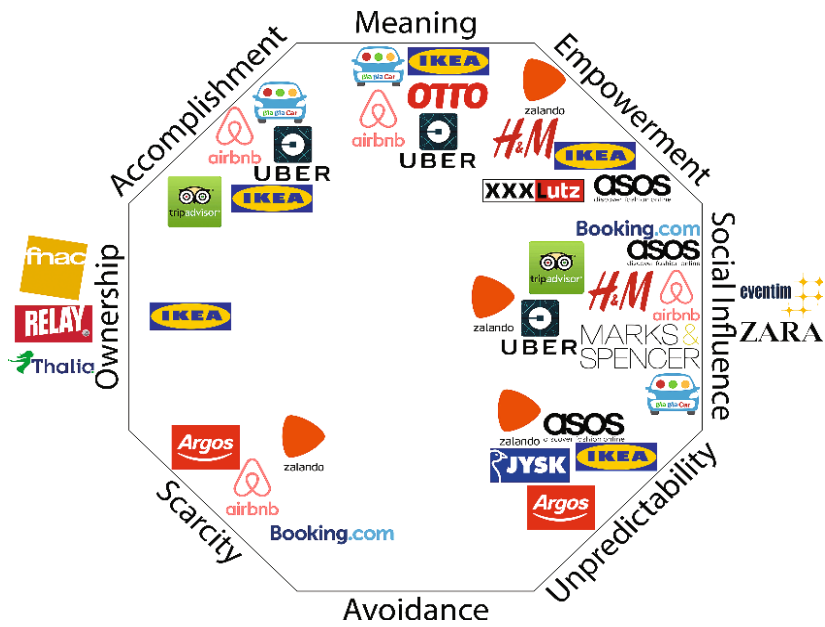




**Figure 4.16: The Octalysis gamification framework (Yu-kai Chou, 2012)**

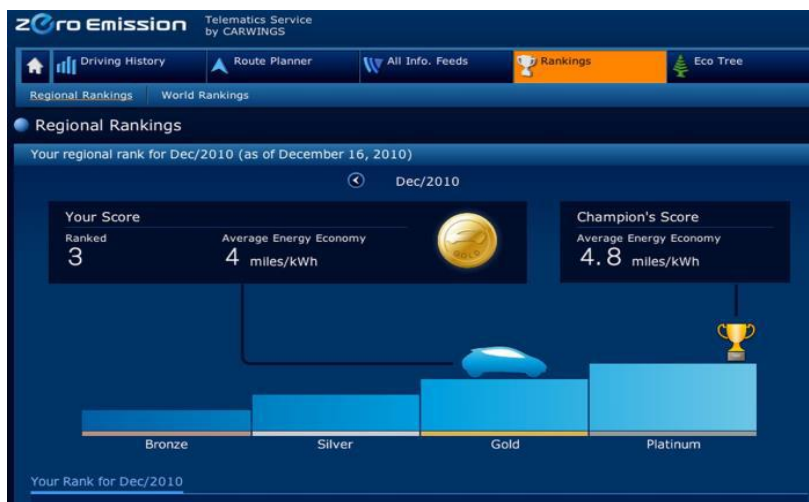
I pointed out the eight sides (main drives) and their two subcategories of *White hat* and *Black hat* drives in the upper and the lower halves of the octagon. I highlighted the human-centred approach of the Octalysis and how the game industry integrates game elements (meaning, accomplishment, unpredictability, etc.) into their procedures to engage players to perform seemingly ordinary and almost repetitive tasks on video and digital games. I used the Octalysis framework to elaborate the elements that game designers incorporate in digital games to motivate and engage those who play such games, which is their intended purpose.

From the literature search on gamification, we discussed different models of the Octalysis that showed how gamification is being applied in industry. One key example I used to direct the interactions was the Karać and Stabauer Octalysis model (see Figure 4.17) which depicts how familiar organisations like IKEA, Marks & Spencer and Uber are taking advantage of different game elements and the *White hat* gamification core drives in particular, to improve customer experience in the European market.



**Figure 4.17: The Karac and Stabauer (2017) gamification model**

The next phase of the interaction focused on *green gamification* and how some gaming systems are applying this concept. The examples that were discussed include the *Nissan Leaf Carwings* system (see Figure 4.18) that ranked and rewarded fuel-efficient driving performance (Pho & Dinscore, 2015:1; Kim, 2015:12) and other sustainability systems on recycling that the students found from their internet search.



**Figure 4.18: The Nissan Leaf Carwings system for ranking eco-driving performance across drivers in proximal geographic areas (as viewed in a web browser) (Froelich, 2015)**

## **LEVEL 5: Day Two, Session Three activities**

### **4.4.5 Engaging with sustainability through gamification**

This section describes the design-led workshop activities that were adopted to engage the students to explore game-based tools and mechanics in learning experiences through sustainable design practice. The descriptions have been done in relation with the illustrations, digital photographs, audio and video recordings that served as a means to document the design-led workshop processes and events as they proceeded. These visual-based design tools (Seidel & Fixson, 2012:3; Debrah *et al.*, 2015:6; Gray & Malins, 2004:72) were used to prompt discussions, the recall of events and to enhance appreciation of the narrative expression of what occurred during the workshop activities. They also helped to document data for the entire research process. Thus, harvesting of the students' ideas on environmental sustainability was done via design thinking strategies that included conceptualising, illustration, storytelling and brainstorming.

To demonstrate their learning on climate change and sustainability issues, the students worked on design projects that required the use of their preferred graphic design tools (text, image, video, etc.) to develop sustainable advertising campaigns to advocate climate change issues in Ghana. The students incorporated illustrations, photos, audio and video recordings in the sustainable design projects they worked on. The students initiated the projects in response to pressing local environmental sustainability issues that focused mainly on illegal logging of forest reserves, illegal mining (*galamsey*), sanitation, water pollution and deforestation, amongst others.

These projects were designed to serve as solutions to sensitise people to local environmental problems and to sensitise people in Ghana to desist from engaging in practices that hurt the environment. The designs cautioned the public on the negative effects of the identified practices that included *galamsey*, indiscriminate dumping of refuse, deforestation, poor sanitation for the natural environment and human lives. The students' designs also encouraged people to consider other sustainable ways of making a living from the natural resources that are available in the country.

The artefacts that emerged from the students' projects to demonstrate sustainable design included flyers, digital photographs, videos, posters, branded T-shirts, advertising jingles and placards for sustainability awareness campaigns. The students' designed projects were used to prompt

discussions and/or recall events during the participatory design workshop activities. Figures 4.19 – 4.21 show examples of the students' designed projects.

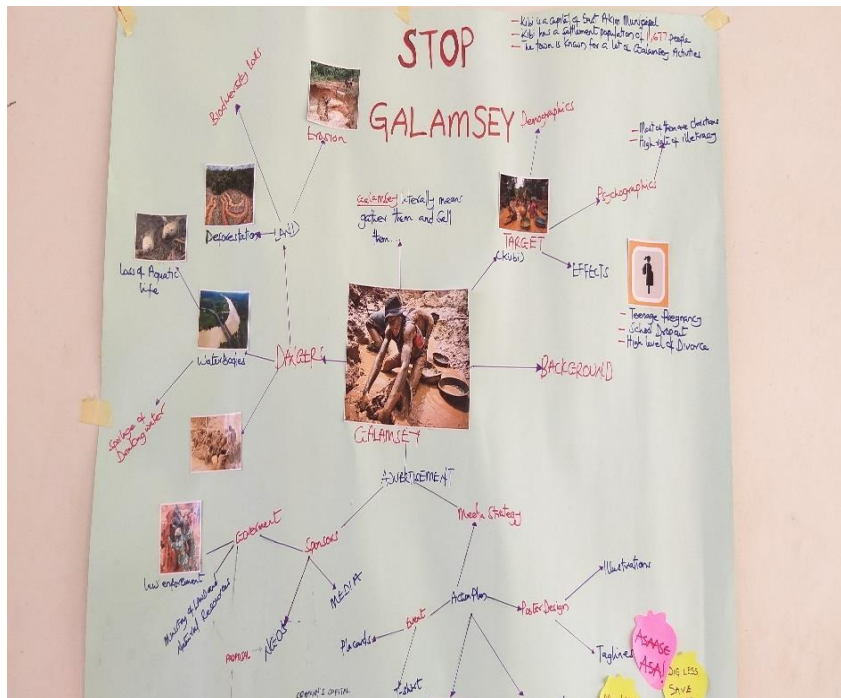


Figure 4.19: Poster on illegal mining (*galamsey*) (Workshop participants, 2019)

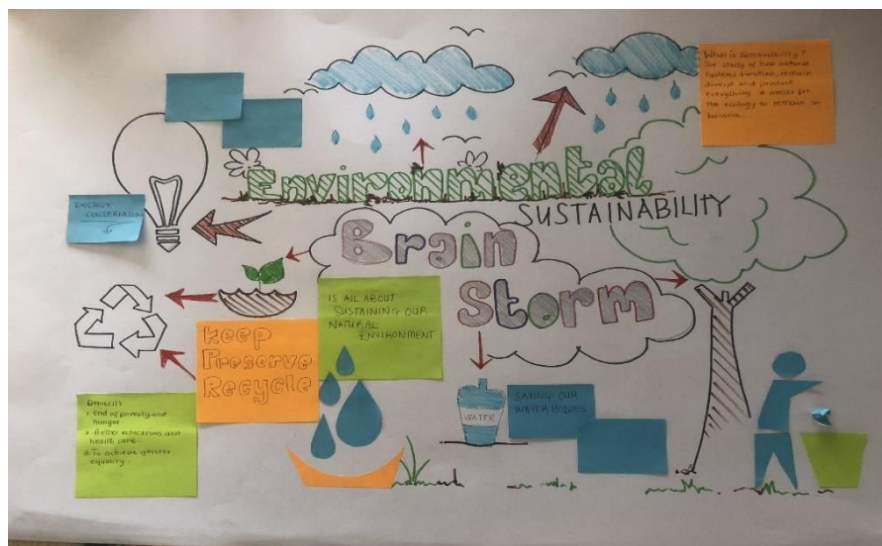


Figure 4.20: Poster on environmental sustainability strategies (Workshop participants, 2019)

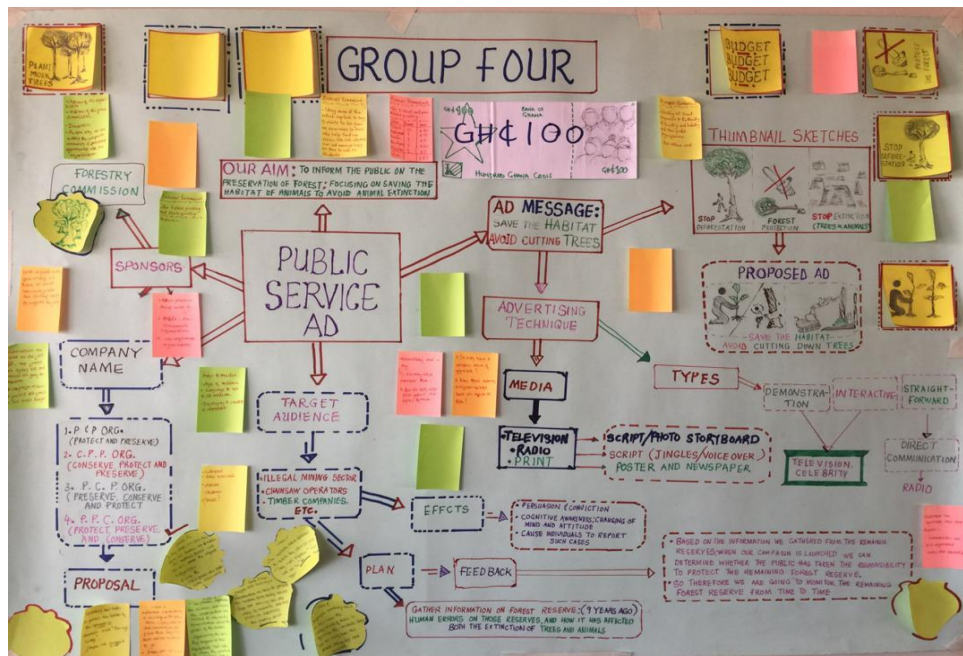


Figure 4.21: Poster on forest conservation strategies (Workshop participants, 2019)

#### 4.4.6 The core design activities

Group work in collaborative teams (Collins, 2010:29) characterised the two-day design-led, participatory, design-based gamified workshop sessions. This was done to promote active collaboration among the students and enable co-creation of design solutions (Liedtka, 2015; Fixson & Siedel, 2014) to demonstrate their learning with game-based tools and mechanics. The basis is that co-designing is a typical design process that promotes collaboration and co-creation of design solutions by groups of designers (Debrah *et al.*, 2015; Chisin & Mainsah, 2014). Figure 4.22 shows the group work sessions.



**a**



**b**

**Figure 4.22: Group work in design workshops** (Workshop participants, 2019)

#### **4.4.7 The gamified activities with Octalysis core drives**

Three core drives in the *Octalysis* gamification model were purposefully selected to inform this study. These were *Epic meaning and calling*, *Development and accomplishment*, and *Empowerment of creativity and feedback*. The game mechanics that guided the design-led workshop activities were *Step-by-step tutorial*, *Instant feedback* and *Higher meaning*. These are key elements in the three selected core drives in *White Hat* gamification. A new set of game mechanics and activities were employed each day. Where any of the sessions exceeded the time allocated to the study, we ended the workshop and continued the activity the next day. This strategy helped to create a level of progression or a level-up system, which is a game mechanic in itself (Galbis-Córdova *et al.*, 2017; Lefers & Birkenkrahe, 2016). The selected core drives also offered a basis to assess the participants' designed artefacts on environmental sustainability. This session offered opportunity for the students to describe the various instances where they had come across the topic of climate change, as well as their experiences as design students in their groups.

In addition, free online gaming applications such as Quizzes, *Kahoot* and a modified version of *30 Seconds*, a South African board game, were explored in the workshops to enhance the selected graphic design students' engagement with environmental sustainability towards inducing sustainable design practice among them. *Kahoot* is a learning game and a popular e-learning tool that can be played online without downloading the application. Its quizzes, discussion and survey options make the *Kahoot* application the most preferred gamification programme. Besides, it can incorporate other media like video, music, sound and photographs (Bicen & Kocakoyun, 2018:75).

These gaming technologies were adopted for the gamified lessons because they allow for the creation and playing of games in any subject and language of choice (Galbis-Córdova *et al.*, 2017; Dias, 2017; Lefers & Birkenkrahe, 2016), including climate change communication and engagement (Rajanen & Rajanen, 2019:262). These workshop activities guided the development of a gamification framework that could be employed for the teaching and learning of environmental and sustainable design practices within the selected context.

The following sections describe how the three core drives in *White Hat* gamification were explored with the students in the design-led workshop activities and learning experiences.

#### 4.4.8 Core Drive One: Epic meaning and calling

*Epic Meaning and calling* in Core Drive One was the first game mechanic that was used to introduce the workshop and give the students a verbal presentation on climate change, environmental sustainability and gamification, as well as to give them the opportunity to ask questions on the topics to encourage reflection as a learning process. After some deliberation on climate change and environmental sustainability effects in Ghana using the *Kahoot* application, each discussion group identified specific local issues they could design solutions for. I encouraged them to use the markers provided to map out the results of their thought processes and discussions on the large manila sheets. Post-it notes were also used to document individual and group ideas. Figures 4.23 shows discussion, brainstorming and mind mapping sessions and outcomes.



a

b



c

d

**Figure 4.23: Discussion and mind mapping sessions** (Workshop participants, 2019)

It was interesting hearing the students share their experiences on electricity rationing that came about from drought-induced hydro power generating challenges encountered in Ghana a few years previously (see also Kayaga *et al.*, 2020). The students moreover kept talking about their previous experiences with certain gaming tools and the ongoing learning on environmental sustainability and climate change they were gaining within the context of design lessons.

#### **4.4.9 Core Drive Two: Development and accomplishment**

This core drive works on the principle of internal drive or intrinsic motivation for making progress, increasing skills, accomplishing mastery and overcoming challenges to earn a badge or reward.

The activities that were employed in Core Drive Two included playing *30 Seconds*, a South-African board game that tests general knowledge (see Figure 4.24). This game is geared mostly towards the *White Hat* core drives of *Accomplishment and meaning*. It involves the use of almost all the elements of the *Accomplishments* drive.





**Figure 4.24: The original 30 Seconds board game (Google images)**

Playing *30 Seconds* requires the players to guess a word that represents a description or an explanation given by a teammate (five words on a card), all within 30 seconds as the name of the game suggests. This is very similar to the game of *Charades*, where clues are given to players by a teammate for one of them to guess the correct word. The clues given are generally short and often emphasise the synonyms of those words and phrases that the “describer” must attempt to decipher from the clues given and mention the correct word in 30 seconds. For example, if the answer to a question is “Recycle”, then the clue may be as simple as “What do you call the process of having plastic remade into another product?”

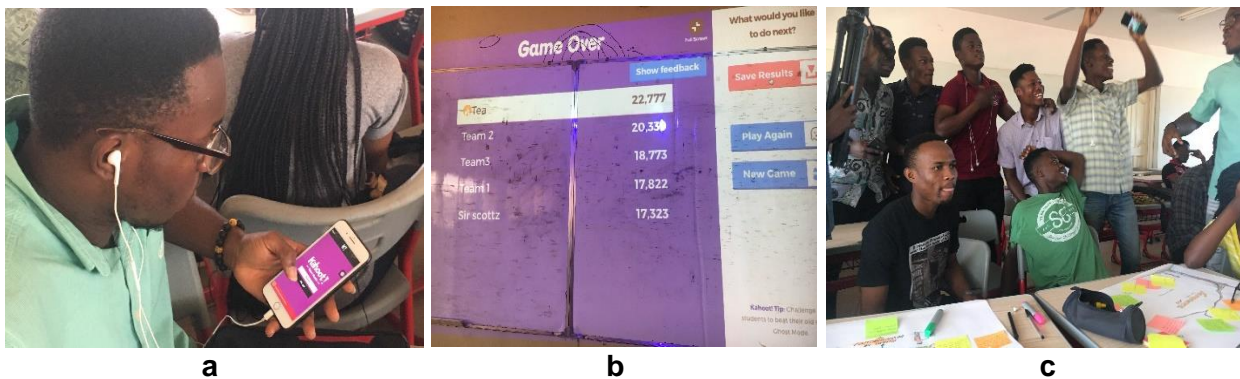
For the purposes of this study, I adapted this game by redesigning the boards differently using text, prototype images of the globe, the sun, fish and butterflies to represent the concept of life on Earth as well as in layout and colour. The focus here was climate change, this version of the game was labelled “Climate Change Edition”. I made the prototype and used it for the demonstration activity and then the students created their own versions. They designed individual tiles on the computer and stacked them together to create their versions. Some of the students printed their designed game as tiles on manilla cards and later glued them for easy handling and use. The modified version of the *30 Seconds* game is shown in Figure 4.25.



**Figure 4.25: The 30 Seconds board game “Climate change edition” (Author’s construct)**

This *30 Seconds* game mechanic was explored to enhance the students’ engagement with climate change and environmental sustainability concepts and as a playful way of testing the students’ knowledge on climate change at the end of the day’s session of activities. Scores were tallied at the end of each session during the game to provide a means of ranking the teams.

Adopting the *30 Seconds* game offered an opportunity for me to find out if the students would remember the climate change topics we had discussed during the brainstorming, presentation and design thinking sessions. The game was played in teams and the points they obtained were used to rank the teams. The game was played on mobile phones and laptop computers (see Figure 4.26).



**Figures 4.26: Scenes from 30 Seconds card game sessions (Workshop participants, 2019)**

Essentially, the playing of *30 Seconds* required the students to interact with one another using gestures and actions instead of using speech and words. This creative way of communicating

presented a unique challenge to the players as they had to keep reminding themselves and each other in different ways that they were not allowed to speak out words even during their group interactions. This game was accompanied by the *Step-by-Step Tutorial* mechanic. It was used to convey and explain the rules of the 30 Seconds game to the students before the start of the game. During this competitive game session, the “rivalry” that emerged between the various teams exhibited the *Quest-list* and *Leaderboard* mechanics that spurred them on to compete and achieve the goal of promoting environmental sustainability in their groups.

The session recorded several “high five” moments as the students cheered each other on during the various rounds of the 30 Seconds game. “High fives” were also observed at the end of the final round of the game as the points earned by the groups and rankings of the teams were announced. The excitement emanated from the wins the students made against their colleagues in other teams. The atmosphere in the session showed that the students enjoyed the game of 30 Seconds for the opportunity it offered for them to play an unfamiliar learning game that also enabled them to assess their efforts at the game.

The results showed that the students had understood the information we shared on climate change in the earlier sessions. The *Instant feedback* they experienced with this game was obvious to the students. They were unanimous in figuring out the contrast between the instant feedback scenario this game-based learning offered and the *wait time* that was required after turning in class assignments or taking tests after their usual lessons. They likened the quick feedback they experienced to what they had experienced with *Kahoot* earlier in the sessions.

#### **4.4.10 Core Drive Three: Empowerment of creativity and feedback**

*Empowerment of creativity and feedback* is conveyed when users are engaged in a creative process where they frequently find out new things and have the freedom and ability to try new or different combinations to achieve their goal. This drive enables users to express their creativity during the process of play and see the outcome of their creativity through feedback, which gives them the opportunity to adjust their engagement further to gain a higher sense of meaning (Chou, 2015:1). Core Drive Three creates euphoria or “feel good” status when the players make efforts to incorporate elements of sustainability into their activities.

During the design thinking and brainstorming sessions, the students discussed the topic of environmental sustainability, climate change and the role designers play in both scenarios. While

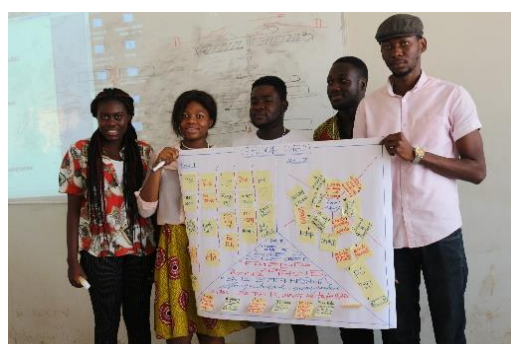
the discussions were going on, I visited each group and observed how they were sharing their knowledge on these topics among themselves, how they worked to agree on a central theme and how they documented them on the manilla cards provided. The *Narrative* and *Higher Meaning* mechanics were mostly operating as the students discussed the challenge. At the end, the students presented their group findings to the larger group and received instant feedback as part of the mechanics employed for the session. Figures 4.27 and 4.28 show the group presentation sessions.



**Figure 4.27: Monitoring and group presentation session** (Workshop participants, 2019)



**a**



**b**



**c**



**d**

**Figures 4.28: Presentation sessions** (Workshop participants, 2019)

Projects the students initiated in response to pressing local environmental sustainability issues focused on illegal logging of forest reserves, illegal mining (*Galamsey*), sanitation and deforestation. They incorporated illustrations, photos, audio and video recordings in the design projects they worked on to demonstrate their idea of sustainable graphic design practice (see Figures 4.19, 4.21.). The artefacts that emerged from the projects took the form of digital images, videos, posters, printed images on T-shirts, advertising jingles, television commercials and placards, among others. These students' projects focused on identifying climate change and environmental sustainability problems in Ghana, which could be solved through design to effect change.

The learning activities were characterised by open display and active presentation of each group's project. The process enabled members of other groups to ask questions of the presenters, critique the projects, and assess the extent to which the core values of environmental sustainability and sustainable design practices had been incorporated in them.

The class graded each project and participated actively in judging the best three projects for awards. They left the final decision to assess the artefacts to the course educator. The study period ended before the students completed the tasks. The students submitted their projects at the end of coursework as part of their design portfolio. However, the focus in this research case was more about the process and the need to draw the students' attention to core concepts in climate change and environmental sustainability. The three best-executed sustainability projects were awarded certificates of participation and trophies (see Appendix F). *Game over! 500 points.*

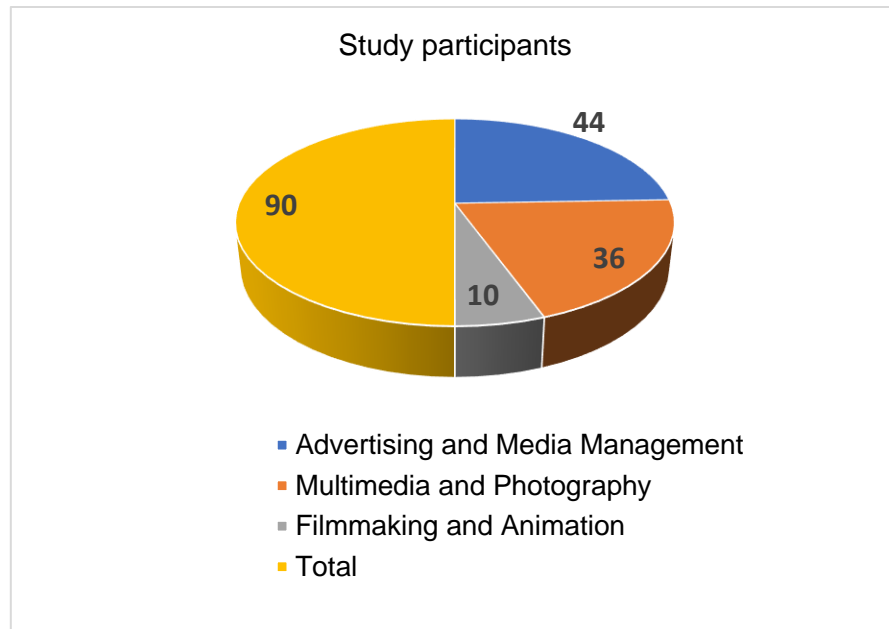
#### **4.5 Phase 2 survey findings**

Before the gamified learning experiences in the design workshops ended on Day 2, the modified version of the original 23-item questionnaire that had provided the basis for the gamification application was administered to the Phase 2 group of 90 students. The aim was to find out if the outcome of the tutorials and interactions on climate change and environmental sustainability, and the design-led workshops would reflect in refined responses to demonstrate successful learning outcomes from this game-based learning application. The findings are presented in the following sections.

## 4.5.1 The research context

### 4.5.1.1 Study participants

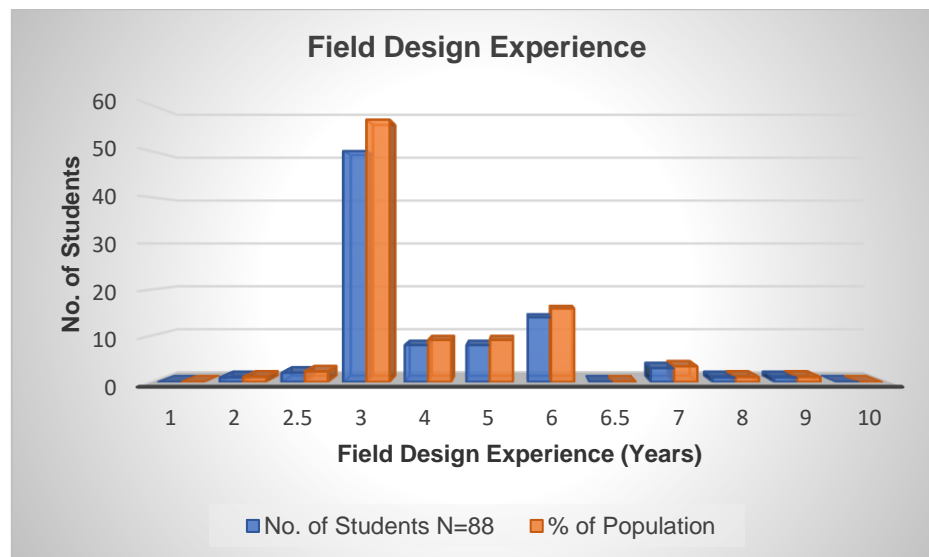
The majority (80, representing 88.9%) of this Phase 2 group of 90 students were majoring in Advertising and Multimedia and 10 (representing 11.1%) were in Filmmaking and Animation. The details are illustrated in Figure 4.29.



**Figure 4.29: Phase 2 participants**

### 4.5.1.2 Design experience

Eighty-eight students answered this survey item. Fifty (representing 56.8% of the 88) reported three years of field design experience. The remaining 38 reported field experience of four to nine years. The details are illustrated in Figure 4.30.



**Figure 4.30: Participants' field design experience**

#### 4.5.2 Knowledge about CC and ES

All 90 students answered this item according to the options of responses provided. The responses to this item showed that 33 of the students understood climate change in terms of “weather conditions” while 25 associated the concept with “change in climate due to human activities”. The other responses are shown in Table 4.14.

**Table 4.14: Knowledge about climate change**

<b>Knowledge of climate change</b>	<b>N</b>	<b>Percent</b>
Pattern of weather conditions	33	36.7
Change in climate due to human activities	25	27.8
Rate of natural resources depletion	11	12.2
Change in global or regional climate patterns	21	23.3
<b>Total</b>	<b>90</b>	<b>100.0</b>

Knowledge of environmental sustainability was demonstrated by 35 of the Phase 2 group of 90 students in terms of “measures to protect the environment” while 22 expressed this knowledge in terms of “maintenance of natural resources”. The other responses are shown in Table 4.15.

**Table 4.15 Expression of environmental sustainability**

<b>Knowledge of environmental sustainability</b>	<b>N</b>	<b>Percent</b>
Maintenance of the environment	15	16.7
Renewing depleted resources	18	20.0
Putting in measures to protect the environment	35	38.9
Maintenance of natural resources	22	24.4
<b>Total</b>	<b>90</b>	<b>100.0</b>

#### 4.5.2.1 Familiar aspects of environmental sustainability

This item received 90 responses. Thirty of the students cited “afforestation and waste recycling” as the aspects of environmental sustainability they were familiar with. The other responses are shown in Table 4.16.

**Table 4.16: Knowledge about environmental sustainability**

<b>Environmental sustainability</b>	<b>N</b>	<b>Percent</b>
Maintaining the natural habitats and resources	15	16.7
Reducing the effects of climate change on ozone layer	22	24.4
Protecting the environment from being destroyed	23	25.5
Afforestation	16	17.8
Waste recycling	14	15.6



#### 4.5.2.2. Sources of knowledge about CC and ES

Two students did not respond to this item that required the students to select the options of responses on the different sources of information on the two concepts. The responses pointed at *Television/ Radio /Newspaper /Internet* as the main source of information about climate change and environmental sustainability. This option recorded 84 (representing 94.5%) of the 180 multiple responses. The option that recorded the least number of responses was *Friends and family* which elicited 28 responses. Details of the other responses are provided in Table 4.17.

**Table 4.17: Sources of CC and ES information**

	<b>N=90</b>	<b>Percent</b>
Television/Radio/Newspaper/Internet	84	46.7
Specialist publications/academic journals/ Environmental groups (e.g., Wildlife Ghana)	21	11.7
School/college/university/Government agencies/ information/Public libraries	47	26.1
Friends/ family	28	15.5
<b>Total</b>	<b>180</b>	<b>100.0</b>

#### 4.5.3 Interest shown in CC and ES issues

##### 4.5.3.1 Importance of climate change

All 90 students answered this item. Those who rated climate change as *very important* numbered 47 and formed 52.2 per cent of the population of 90 students. Those who rated the phenomenon *important* totalled 32 (representing 35.6%) and those who rated it *quite important* numbered 11 and formed 12.2 per cent of the total respondents.

##### 4.5.3.2 The meaning of climate change

This item sought to find out how the students understood climate change in relation to any of the five factors that applied to them. This item recorded multiple responses. Those who associated the meaning of climate change with *change in climate due to human pollution* numbered 68 while

those who related the concept to *change in the environment* totalled 65. The other responses are shown in Table 4.18.

**Table 4.18 Meaning of climate change (multiple responses)**

	<b>N</b>	<b>Percent</b>
Change in temperature	54	19.1
Change in the environment	65	23.0
Change in weather conditions	37	13.1
Change in climate due to human pollution	68	24.0
Change in climate due to global warming	59	20.8
<b>Total</b>	<b>283</b>	<b>100.0</b>

#### 4.5.3.3 Causes of climate change

Twelve students did not answer this survey item. Among the 78 students who responded to this item, 22 and 19 students respectively, cited *human activities* and *pollution* as causes of climate change. Three students cited *illiteracy and ignorance*. The other responses that were provided are shown in Table 4.19.

**Table 4.19: Causes of climate change**

	<b>N=78</b>	<b>Percent</b>
Pollution	19	24.4
Human activities	22	28.2
Industrial activities	16	20.5
Natural occurrences	5	6.4
Illiteracy and ignorance	3	3.8
Deforestation	13	16.7
<b>Total</b>	<b>78</b>	<b>100.0</b>

#### 4.5.3.4 Effects of climate change

In the global context, *global warming*, followed by *rising temperature* were selected by 79 and 73 students, respectively, among the 357 responses provided by the 90 students. The details of the other climate change effects cited are shown in Table 4.20.

**Table 4.20: Effects of climate change**

	<b>N=90</b>	<b>Percent</b>
Drought	57	16.1
Flooding	48	13.4
Global warming	79	22.1
Rising temperature	73	20.4
Sea level rise	40	54.8
Increasing intensity and frequency of extreme weather events	52	14.6
<b>Total</b>	<b>357</b>	<b>100.0</b>

#### 4.5.3.5 Impacts climate change may have on the environment

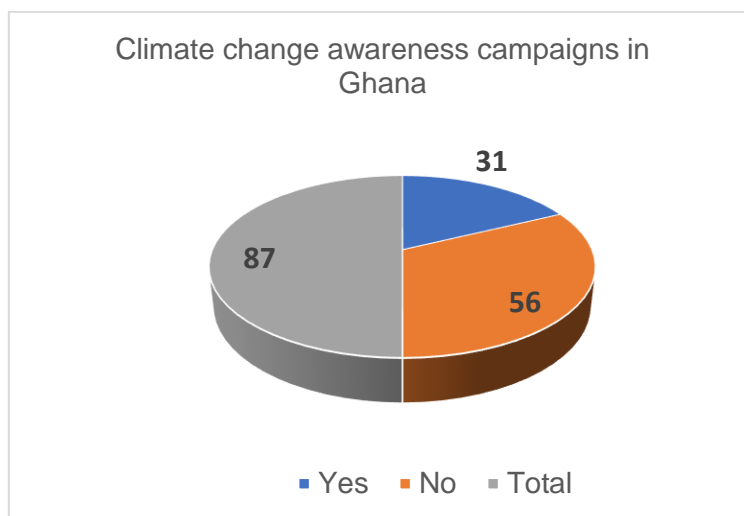
This question sought to extract the students' knowledge about what impact climate change may have on the environment by ticking options from expected responses. The 300 multiple responses indicated most of the students (64) selected *Global warming* while the lowest number (40 each) selected *Flooding* and *Sea level rise*. The details of the 300 multiple responses are shown in Table 4.21.

**Table 4.21: Impacts climate change may have on the environment**

	<b>N=90</b>	<b>Percent</b>
Drought	47	15.7
Flooding	40	13.3
Global warming	64	21.3
Rising temperature	62	20.7
Sea level rise	40	13.3
Increasing intensity and frequency of extreme weather events	47	15.7
<b>Total responses</b>	<b>300</b>	<b>100.0</b>

#### 4.5.3.6 CC awareness campaigns in Ghana

Three students did not answer this survey item. Fifty-six (representing 64.4%) of the 87 students who responded to this survey item denied awareness of climate change campaigns. Those who confirmed this occurrence are shown in Figure 4.31.



**Figure 4.31: CC awareness campaigns in Ghana**

Occurrence of climate change awareness campaigns in the HEI in the study recorded 48 (representing 66.7%) *No* responses from the 72 students who responded to this survey item. The different responses are shown in Table 4.22.

**Table 4.22: Climate change awareness campaigns in the HEI**

	<b>N=72</b>	<b>%</b>
Yes	12	16.7
No	48	66.7
Not enough	4	5.6
Not sure	8	11.0
<b>Total</b>	<b>72</b>	<b>100.0</b>

#### 4.5.3.7 Schools teach students about climate change

All 90 students answered this survey item that sought to know if schools in Ghana teach their students about climate change. This item recorded 78 (representing 86.7%) Yes and 12 (or 13.3%) No responses. The details are shown in Table 4.23.

**Table 4.23 Schools teach students about climate change**

	<b>N</b>	<b>Percent</b>
Yes, but not in detail	7	7.8
No	12	13.3
Yes	71	78.9
<b>Total</b>	<b>90</b>	<b>100.0</b>

**4.5.3.8 I was taught about CC.** All 90 students responded to this survey item. Those who reported being taught about climate change prior to enrolling in this HEI totalled 78 (representing 86.7%) and those who reported that they were not taught about climate change numbered 12 and formed 13.3 per cent of the sample.

**4.5.3.9 Something can be done to tackle CC.** Five of the 90 students did not respond to this survey item. On whether anything can be done to tackle climate change, 76 (representing 89.4%) of the 85 students who answered the question stated Yes. The remaining 9 stated No.

**4.5.3.10 Measures for tackling climate change.** The question of whether measures exist for tackling climate change was answered by 87 of the 90 students. The responses recorded include mounting *awareness campaigns* and *encouraging recycling of plastic waste*, which were cited by 21 and 17 students respectively. The other measures cited in the students' responses are shown in Table 4.24.

**Table 4.24: Measures for tackling climate change**

	<b>N=87</b>	<b>Percent</b>
Awareness creation campaigns on CC	21	24.4
Public and institutional education	16	18.6
Afforestation	8	9.3
Encouraging recycling of plastic waste	17	19.8
Regulating human activities that pollute environment	13	15.1
Enforcing regulations to curb pollution from industrial activities	11	12.8

#### 4.5.3.11 Climate change impacts that will affect Ghana

All 90 students responded to this survey item. The responses showed that all the six climate change impacts cited in the survey item will affect Ghana's environment. The impact that recorded the most responses was *rising temperatures*, which was selected by 43 of the students. This was followed by *drought*, which was the option selected by 28 students. The other responses are shown in Table 4.25.

**Table 4.25: CC impacts that will affect Ghana (multiple responses)**

	<b>N =90</b>	<b>Percent</b>
Sea level rise	6	4.3
Drought	28	20.0
Flooding	27	19.3
Global warming	31	22.1
Rising temperatures	43	30.7
Increasing intensity and frequency of extreme weather events	5	3.6
<b>Total</b>	<b>140</b>	<b>100.0</b>

#### 4.5.3.12 Entities in Ghana to be mostly affected by climate change impacts

All 90 students answered this survey item. The majority (65 or 79.3%) of the 82 study participants who provided answers to this survey item, cited people in Ghana as those who will be mostly

affected by the consequences of climate change. Details of other responses are shown in Table 4.26.

**Table 4.26: Ghanaian entities to be mostly affected by CC impacts**

	<b>N=90</b>	<b>Percent</b>
Agriculture /economic activities	9	10.0
Everyone living in the country	60	66.7
Plants/animals/living organisms	10	11.1
The environment	11	12.2
<b>Total</b>	<b>90</b>	<b>100.0</b>

#### 4.5.3.13 Personal changes to minimise climate change effects

All 90 students responded to the question. Twenty of them cited *creating awareness*. The other responses that were recorded are shown in Table 4.27.

**Table 4.27: Personal changes to minimise CC effects**

	<b>N=84</b>	<b>Percent</b>
Create CC awareness	20	30.3
Join a campaign team	16	24.2
Use design for education	18	27.3
Education	16	24.2
Changing my ignorant attitude	14	21.2

#### 4.5.4 How designers contribute to climate change and ES

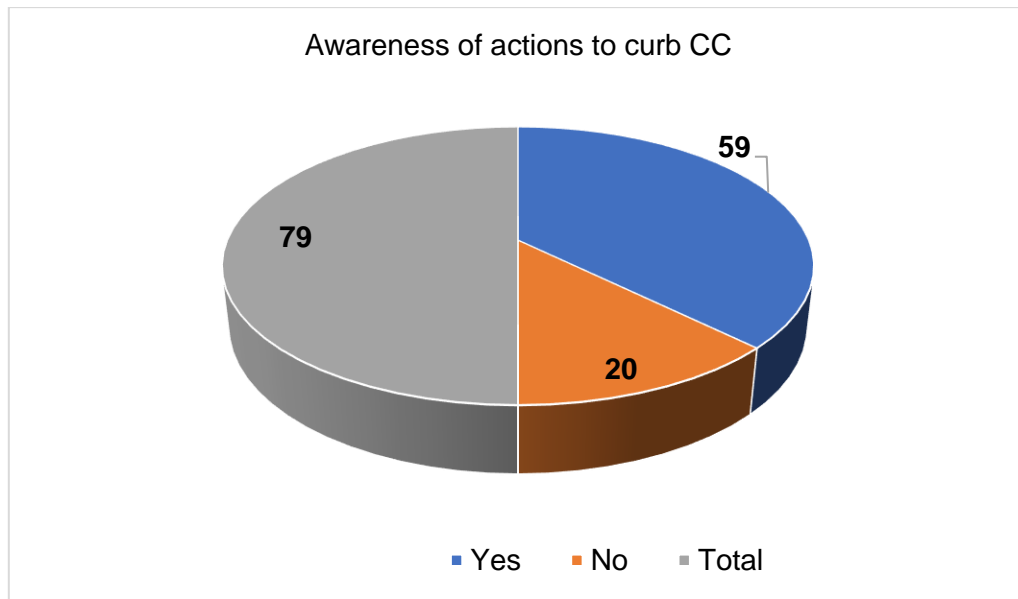
The majority (67 or 60.1%) of the 110 multiple responses that were given by the 82 study participants focused on the design and use of visual and motion graphics to communicate climate change messages for awareness campaigns and public education. The various responses are provided in Table 4.28.

**Table 4.28: Designers' role in climate change and ES**

	<b>N=82</b>	<b>Percent</b>
Design visuals	45	40.9
Public education	21	19.1
Create awareness campaign	44	40.0
<b>Total</b>	<b>110</b>	<b>100.0</b>

#### 4.5.4.1 Awareness of actions to curb CC

The issue of what can done to curb climate change was answered by 79 of the 90 study participants. The Yes responses that expressed this awareness totalled 59 and formed 74.7 per cent of the total responses. Figure 4.32 shows the details.



**Figure 4.32: Awareness of measures to curb CC**

#### 4.5.4.2 Suggested actions for designers to help solve the CC problem

Products of design were suggested as measures that designers can adopt to help solve the problem of climate change in order to sustain the environment. The 90 study participants mainly suggested the use of posters, videography, pictures or graphical imagery, designed T-shirts,



banners, fliers, etc. bearing the CC message to create awareness to make people conscious of the situation. Table 4.29 shows the summary of the responses.

**Table 4.29: Actions designers can take to solve the CC problem**

<b>Suggested action</b>	<b>N = 90</b>	<b>Percent</b>
Creating awareness with design	19	21.1
Creating visual communication materials	14	16.7
Education of general public	24	28.9
Encourage use of renewable forms of energy	21	24.4
Use designs to expose bad human activities	7	7.8
Regulate human activities	5	5.6






#### **4.6 Chapter summary**


The descriptions provided in this chapter depict the kind of interactions that occurred in the design education environment within the six-hours of the three lesson periods that were allowed for this gamified study. It highlights how the main gaming concepts, namely, *Rapid feedback*, *Flow* and *Leaderboards* were explored with the students in the design-led workshop activities and learning experiences with respect to the three main Octalysis core drives of *Epic meaning and calling*, *Development and accomplishment*, and *Empowerment of creativity and feedback*. These elements underlined the investigation in relation to climate change and environmental sustainability.







The data assembled here graphically make clear how the two groups of graphic design students understood climate change and environmental sustainability at the conversation stage (Phase 1) and Phase 2, in relation to what occurred after the students had been introduced to gamification applications during the design-led workshop activities. The chapter also has details of the procedures and processes that the students were taken through using the application of the gaming mechanics of *Kahoot*, the “climate change edition” of *30 Seconds*, design thinking and brainstorming with mind mapping sessions, and specific local issues through which they designed and created solutions for in response to the gamified learning activities. The survey responses depict how the activities shaped their philosophy with respect to the two concepts and the





differences that show through the graphical representation. The data clearly underscore the view that “underlying the concept of gamification is motivation” (Nicholson, 2012:1), which is a challenge that teachers face in the field of education (Lee & Hammer, 2011; Manzano-León *et al.*, 2021) and creates the need for experiential learning (Jose *et al.*, 2017; Kolb & Kolb, 2017) through such tools as gamification, a relatively new 21st century approach to motivating a user to act (Byrne, Ito & Furuyabu, 2022) on account of the fun that underlines gaming (Kim, 2015; Bicen & Kocakoyun, 2018).





The analysis and interpretation of the data assembled in this chapter are provided in Chapter Five.

Setting Time	Activity	Learner role	Educator role	Tools/ Resources
<b>PRE-TASK</b>  A week online (1hr)	Pre-task  Introduction to the course.	Read email and watch video and other learning materials. Learners respond to pre-task activities and submit online before coming to class.	Send email to students and provide other related learning materials on environmental sustainability and climate change.	Google classroom  Gmail, Google docs, Google slides, Google drive.
<b>F2F</b>  10mins	Welcoming students.  Pre-task discussion. Students will watch 1min. introductory video on the topic to gain their attention.	<u>Students listen and watch.</u> <u>They ask questions when</u> <u>needed.</u>  	Introducing students to the course objectives and test prior knowledge on pre-task activities. 	PowerPoint, Google drive  Google slides
<b>F2F</b>  10mins	Introduction to environmental sustainability and climate change.  Identification of different aspects of environmental sustainability	Group work, students list possible aspects of environmental sustainability and climate change.  	Instructor delivers lessons and gives task to learners with support from facilitators.   	Google slides, MS word, Google drive

Setting Time	Activity	Learner role	Educator role	Tools/ Resources
	based on prior knowledge in pre-task activity.			
<b>F2F/ Online</b>  10mins   10mins	Main lessons on Environmental sustainability and sustainable brand production begins.  Gamification (break)	Learners listen and ask questions when they need clarity.   Gamification	Instructor delivers lessons on:  1. Environmental sustainability and climate change.  2. Sustainable brand production principles and processes.  Gamification	Google slides Google sites Google drive Gamification (e.g., Kahoot)
<b>F2F</b>  30 Mins	Step 1: Studio practice  Brainstorming activities on layout and	Learners work in groups and create possible layouts for an ad campaign for sustainable	Instructor provides support to learners while they work.	PowerPoint slides Google slides Google drive

Setting Time	Activity	Learner role	Educator role	Tools/ Resources
	design for sustainable brand production.	brand production (public service advert) 	 	
<b>F2F/ Online</b> 10mins  15mins	Step 2: Studio practice and feedback session from the various groups.  Gamification (break)	Learners begin to wrap up and prepare for presentations to class.   Gamification	Instructor prompts learners to use online tools. Facilitators provide support to learners while they work.    Gamification	<b>Online tools:</b> PowerPoint slides, Google sites, Google docs, Google classroom, <b>Devices:</b> Computers, Projector, Smart Phones Gamification ( <i>Kahoot</i> or <i>Bingo</i> )
<b>F2F/ online</b> 30mins	<b>Close of Day/ Assessment</b>  Review of the day's activity on environmental sustainability.	Learners wrap up with practicing and organising their layouts for the first iteration of the sustainable brand production public service ad.  Feedback sessions and group presentations.	Facilitators provide support to learners while they complete their task.  Review of day's activity, formative assessment.	PowerPoint slides, Google sites, Google docs, Google classroom,  Devices: Computers, projector, smart phones.

Setting Time	Activity	Learner role	Educator role	Tools/ Resources
	Feedback sessions and assessment.		Reminder of homework and submissions of works.  	
<b>Online</b>  1 week	<b>Homework/ Assessment</b>  Developing an ad campaign for environmental sustainability and assessing contents as part of the advertising production course.	Students read email and details of homework and continue exploring at home and online activities continue.  	Instructor provides clarity on homework and submission deadlines once again.  Tips for formative assessment and how to improve design studio project and include their ePortfolios for assessment. 	Google classroom, PowerPoint, Google sites/ docs, videos, PDFs, smart phones, computers.  Devices: Computers, projector, smart phones.

Setting Time	Activity	Learner role	Educator role	Tools/ Resources
<b>Key</b> <b>Group activities</b>	 <b>Teacher and facilitators observing and supporting students at work.</b>	<b>Learner role</b> 	<b>Teacher role</b> 	 <b>Activity</b> <b>Tools/</b> <b>Resources</b>
<b>Goal</b>	Create awareness on sustainable advertising (Lesson 1: on environmental sustainability)			
<b>Sample Rubric</b>	Check Google class (to be provided)			
<b>Sample Homework</b>	Check Google class (to be provided)			

<p><b>Notes</b></p>	<p><b>Sustainable Advertising Production: CLIMATE CHANGE AND ENVIRONMENTAL SUSTAINABILITY (Lesson plan: Day 2)</b></p> <p><b>Duration: 2 hours (115 minutes)</b></p> <ul style="list-style-type: none"> <li>➤ <b>GAP:</b> Learners are not aware of sustainable graphic design practices, issues relating to environmental sustainability and climate change.</li> <li>➤ Learners are unaware of sustainable graphic design practices.</li> <li>➤ <b>Learning outcome:</b> Develop a public service advertising campaign that will use graphic design tools to promote environmental sustainability.</li> <li>➤ <b>Activities:</b> Learners will develop a series of advertising campaigns to promote environmental sustainability and climate change.</li> <li>➤ <b>Pedagogical approach:</b> Behaviourist and constructivist approach such as guided instruction and collaborative experimentation, experiential learning.</li> <li>➤ <b>Evaluation (Assessment):</b> Learners will be formatively assessed (peer-peer-assessment of ePortfolio contents on sustainable brand production). Evaluations will be formative (continuous assessment) and summative (end of term).</li> <li>➤ <b>Evaluation of the learning experience:</b> Questions will be provided by instructors online for students to provide feedback on the day's activity to evaluate the learning experience and in the workshop environment.</li> <li>➤ <b>Tools:</b> Google applications such as Google sites, docs, slides, classroom.</li> <li>➤ <b>Devices:</b> Computers, smart phones, etc.</li> </ul>
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**Figure 4.34: The contextualised game-based learning framework (Author's construct)**



## **5 CHAPTER FIVE: ANALYSIS OF THE FINDINGS**

### **5.1 Introduction**

This section of the thesis presents the analysis, discussion and interpretation of the findings that were harvested from the two groups of 75 and 90 graphic design students' ideas and perceptions about climate change and environmental sustainability that were expressed through the responses they gave to the survey items in the Phase 1 and Phase 2 questionnaire administration. It also imparts information on the variety of graphic design tools that the students used to create projects to demonstrate their learning on the two concepts to serve as advocacy to promote environmental sustainability and sustainable futures. It also describes how the gaming concepts of *Rapid feedback*, *Flow* and *Leaderboards* were utilised in designing the gamified learning experiences for the design-led workshops.

The analysis, discussion and interpretation of the students' ideas have been done in relation to the literature reviewed on climate change and environmental sustainability as specified by the research questions that guided the study. Some of the data have been presented in quantitative format as frequency tables, bar graphs and pie charts, as well as in qualitative terms, which includes my personal interpretation of the issues raised and as verbatim expressions of the selected students' ideas on the two concepts.

The three main core drives of the Octalysis gamification model that informed the design workshops and learning activities towards advocacy for sustainable futures through visual designs and artefacts were *Epic meaning and calling*, *Development and accomplishment*, Empowerment of creativity and feedback. The chapter also provides information on the variety of graphic design tools that served as advocacy resources to promote environmental sustainability in the workshops from which data were collected and which provided the gamified learning context described in Chapter Four.

### **5.2 Analysis of the findings**

Data analysis involves transforming data into information that can be used in decision making. It involves editing, correcting errors, rectifying omissions, combining drawing inferences from the raw data gathered (Kothari & Garg, 2014; Terrell, 2016). The inductive approach to qualitative

data analysis (Collins, 2010:92) was adopted. Thematic analysis (Terrell, 2016; Given, 2008), which involves identifying patterns and themes within data, was employed to examine textual data obtained from the questionnaire responses and the visual data obtained from the design workshop activities. The analysis and interpretation of the students' ideas has been done in relation to the literature reviewed on climate change and environmental sustainability as specified by the research questions that guided the study. Reflexivity, which is "the voice of the researcher approach" (Terrell, 2016:175; Gray, 2009:498) was used to describe the findings that emerged from the survey and to report my view of the research findings as a co-constructor of knowledge deduced from the study.

The analysis, discussion and interpretation of the students' ideas has been done in relation to the literature reviewed on climate change and environmental sustainability as specified by the research questions that guided the study. Some of the data have been presented in quantitative format as frequency tables, bar graphs and pie charts, as well as in qualitative terms as my personal interpretation of the issues raised and as verbatim expressions of the selected students' ideas on the two concepts.

This study explored gamification or gamified learning as a pedagogical tool to extend climate change and environmental sustainability thinking to promote sustainable design practice among graphic design students in the department of Graphic Design in Ghana's premier university for design education.

### **5.3 The question-and-answer session experiences**

The question-and-answer session that was adopted to start the gamified learning activities on climate change and environmental sustainability induced the students to reflect on their personal and shared experiences of climate change impacts as seen from where they live in the various parts of Ghana. The topics that formed the basis of the initial interactions and discussions focused on the concept of climate change, climate change effects seen in Ghana, climate change impacts on the natural environment, the concept of environmental sustainability and the related strategies, how the graphic design industry contributes to climate change issues and how design is being used as a tool to promote environmental sustainability and sustainable futures.

There were three key climate change impacts that stood out in the discussion. The first one was the incidence of severe drought in the northern parts of Ghana that caused millet crops to shrivel due to changing weather patterns. The discussion of this issue was informed by Google images that surfaced from the online search for literature on climate change impacts in Ghana. This image sparked much debate as two of the students reported having witnessed similar incidents and also recognised familiar faces in the image. The second one was an image of a flood scene in which people were being rescued. These particular images added a layer of collaboration to what was experienced during the search for online images to support the interactions.

The third one was desertification and shortage of grazing grounds for cattle in Burkina Faso, Niger and Mali, Ghana's immediate northern neighbouring countries that lie in the Sahel savanna regions of West Africa. This matter sparked a heated debate on whether the government should build kraals to contain the migrant cattle as was being discussed in media reports at the time or to sack the herdsmen and charge the cost of the destruction they had caused to their countries of origin. Drought, desertification and loss of the natural plant cover and feeding grounds in the Sahel regions are critical impediments to the progress of Ghana since many of their citizens have also migrated to the country and have become beggars on the streets. These discussions provoked emotional moments for the students who had expressed personal experiences of the climate change-induced impacts from the identified images and stories that had become the basis of debates on radio as well as television documentaries at the time.

#### **5.4 The design projects**

The gamified learning experiences that were designed as workshops were modelled on *White Hat* gamification techniques from the Octalysis framework. This was informed by the knowledge gaps that were identified in the survey responses provided by the Phase 1 group of 75 students before they were introduced to gamification applications.

Typical of the field of design, the students worked in collaborative teams (Collins, 2010:29) to design and create artefacts that demonstrated their collective understanding of climate change and sustainability issues. They used graphic design tools that included mind mapping and design-thinking strategies to respond to specific tasks they discussed with respect to climate change and sustainability issues. They recorded the ideas they agreed upon as groups through mind mapping. At the end of the sessions, each group of students chose to develop contextualised advertising

campaigns or a specific medium of communication using their preferred unique graphic design tools such as text, drawing, audio and video recordings.

The students adopted the familiar design process of collaboration, brainstorming and co-designing to co-create design solutions (Bratteteig, 2014:13; Chisin & Mainsah, 2014) throughout the design-led workshops. They took photographs using cameras and mobile phones, they recorded audios and videos of the events, activities and stories we shared about climate change. They also created artefacts that incorporated the core values of environmental and sustainable design practices as part of the game-based learning activities they worked on during the gamification exercises. The students' artefacts included branded T-shirts that mostly depicted messages on illegal logging, illegal mining (*galamsey*) and deforestation. They also recorded videos of and created posters about poor sanitation and water pollution, among others. The artefacts responded mainly to pressing local climate change and environmental sustainability issues.

The artefacts demonstrated sustainable advertising to advocate climate change issues in Ghana. They also aimed at sensitising people in Ghana to stop engaging in such practices because their negative effects hurt the natural environment, its eco-system and human lives. In addition, the artefacts were designed to caution the public on the adverse effects of the identified illegal practices on the natural environment while also encouraging them to consider other sustainable ways of making a living from the natural resources that are available in the country.

The students' projects were used to prompt discussions and/or recall events during the participatory design workshop activities. The visual-based tools (Collins, 2010:150-151) that included text, videos, drawings, posters, videos and photographs, were useful in documenting the data obtained from the design workshops and the entire research process for analysis and dissemination of the research outputs.

The workshop activities guided the development of a gamification framework that could be employed for the teaching and learning of environmental and sustainable design practices within the selected HEI's graphic design education context. The selected core drives also offered a basis to assess the participants' designed artefacts on environmental sustainability. The three best executed sustainability projects were awarded trophies. Feedback obtained from the students

included their reactions to the gamification system, which they generally described as fun, enjoyable and rewarding in their responses to a survey conducted via Google Forms.

## **5.5 The survey results**

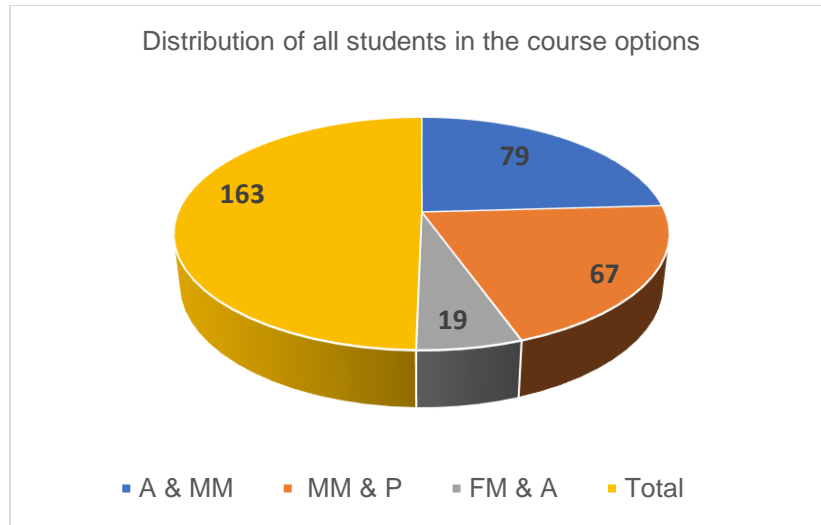
This section describes the research population, their major course specialisations and field design experience. The two groups of third-year undergraduate graphic design students numbered 165 (Phase 1= 75; Phase 2 = 90). The analysis reflects information provided by the number of students who answered the respective survey items on the various themes. The results presented in this section have been illustrated with frequency tables, bar graphs and pie charts.

### **5.5.1 The research context**

This section of the chapter describes the research population of the Phase 1 and Phase 2 undergraduate graphic design students, their major course specialisations and field design experience. There were two groups of third-year students who participated in the study.

#### **5.5.1.1 The study participants**

All the study participants were graphic design undergraduate students who were majoring in Advertising and Media Management (A&MM), Multimedia and Photography (MM&P) or Filmmaking and Animation (FM&A). The overall majority (66 or 88.0%) of the Phase 1 group of 75 students were in Advertising and Media Management and Multimedia and Photography. Filmmaking and Animation had only 9 students. Similarly, Advertising and Multimedia had the majority (79) of the Phase 2 group of 90 students and 10 students in Filmmaking and Animation. Altogether, the two groups of students, numbering 165, were unevenly spread in the three graphic design course options, with most of them in Advertising, followed by Multimedia and Photography. The details of the distribution of the students who participated in the study are illustrated in Figure 5.1.

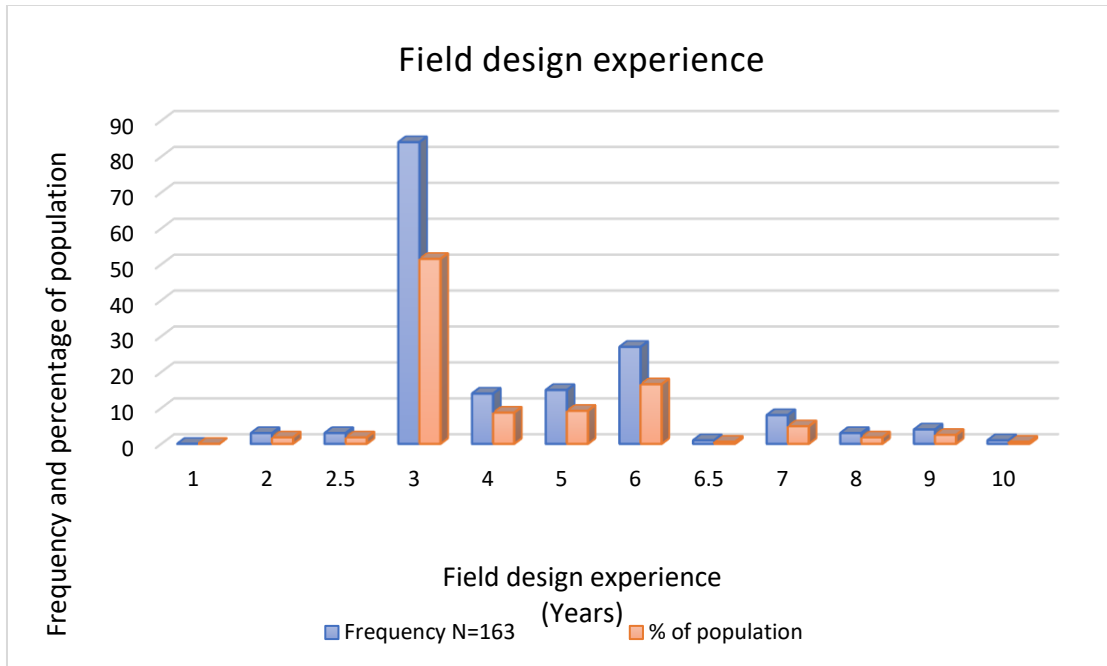


**Figure 5.1: Distribution of the students in the course options**

The data reveals that the different course options had different levels of students. Clearly, Filmmaking and Animation contributed the lowest number (19) of participants to the study. Based on my experience of graphic design education in Ghana, this imbalance in the distribution of study participants is the result of the prominence of advertising and its related topics in the senior high school graphic design curriculum. Filmmaking and Animation as a course is available only in the higher education graphic design curriculum.

#### **5.5.1.2 Field design experience of the students**

Two students did not answer this survey item. The questionnaire responses revealed that 34 of the Phase 1 group of 75 students and 50 of the 88 group of Phase 2 students who responded to this survey item regarding their field design experience listed three years. This means 84 (or 51.5%) of the 163 students who responded to this survey item had been associated with graphic design for three years. The students who reported 4 -10 years of field design experience totalled 79 and formed less than 50 per cent of the population studied. Details of the field design experience reported by the students surveyed for this study are shown in Figure 5.2.



**Figure 5.2: Field design experience of the students**

In this regard, the population of the study participants consisted of a blend of 84 regular and 79 mature graphic design students in their third year of the four-year Graphic Design programme in the HEI that this study is based on. This purposefully selected population provided information-rich data for the study (Creswell, 2014; Fraenkel *et al.*, 2012).

### 5.5.2 Interest in climate change and environmental sustainability matters

The results presented in this section give an idea of the participating students' level of awareness and knowledge of climate change and environmental sustainability issues. Interest in climate change and environmental sustainability was expected to show through the relationship between the study students' responses and current knowledge about the two phenomena. Hence, responses that were considered valid for the purpose of this study were those of 18 students who essentially provided information that reflected literature on the two concepts.

#### 5.5.2.1 Knowledge of climate change matters

Essentially, only the 18 valid responses were factored into the data analysis on account of interest in climate change and environmental sustainability matters.

The 18 responses that were considered valid with respect to how the study participants (coded SP) defined climate change included the following expressions:

- *When the average long term weather patterns of a region are altered for an extended period of time, typically decades or longer (SP 1).*
- *Change in global or regional climate patterns, in particular, a change apparent from the mid to late 20<sup>th</sup> century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels (SP 4).*
- *The change in average weather conditions (SP 2, SP 18, SP 19, SP 21, SP 23).*
- *Change in climate due to conditions such as global warming (SP 27, SP 61).*
- *Change in the climate system when considered over a period of time (SP 55).*

These statements generally reflect aspects of literature on climate such as “the long-term weather patterns that describe a region” (Adedeji *et al.*, 2014:115), “the long-term regional or even global average of temperature, humidity and rainfall patterns over seasons, years or decades” (NASA Goddard Institute for Space Studies, undated), “the long-term variations in global and regional climate patterns” (Pender, 2010), and “the shift in climate normal statistics such as the expected mean measure of warmth and rainfall records of a specific location in a given period of a year and between a decade and the next” (Amekudzi *et al.*, 2017:5).

It is important also to comment on the different kinds of responses that the remaining 57 of this Phase 1 group of 75 students provided. Key interesting responses in this batch were from 17 respondents that stated knowledge on the two concepts as follows:

- *A lot (SP 5)*
- *Basic idea (SP 6, SP 7, SP 8, SP 9)*
- *Basic information (SP 10, SP 11)*
- *Basic knowledge (SP 12, SP 13, SP 14, SP 15, SP 16, SP 17)*
- *Enough (SP 35)*
- *General knowledge (SP 40)*
- *Not very much (SP 59)*
- *Yes (SP 65)*



Another set of 19 responses did not relate to any of the two concepts and 21 others mixed up “bits and pieces” of the required knowledge about the two concepts. Having only a minority (18) of the Phase 1 group of 75 students able to express relevant knowledge about climate change points to the need for the majority 57 students to be educated on the climate change phenomenon.

Like the Phase 1 group of 75 students, all the Phase 2 group of 90 students responded to this survey item that required them to show their understanding of climate change and environmental sustainability. Three of these 90 students provided unexpected responses, namely: “I don’t know anything about climate change and environmental sustainability”; “They [the two concepts] are related” and “Mostly caused by human actions”. These three responses required explanation or clarification but the survey had been answered anonymously, and the workshop and allotted time for the study had also ended.

Altogether, 51 of the Phase 2 responses generally showed more enhanced learning about climate change than the Phase 1 group. Examples of how the 51 student participants (coded SP) expressed their knowledge included the following:

- *Change in global or regional climate patterns which occurs when changes in the earth’s climate system results in new weather patterns (SP 1, SP 2, SP 20, SP 40).*
- *Change in weather conditions and the change in climate due to global warming (SP 23).*
- *Change in climate patterns due to global warming (SP 23, SP 61).*
- *Abnormal variations to climate and the effects of these variations on other parts of the earth (SP 12, SP 13).*
- *The drift in normal climate patterns due to dangerous human activities (SP 56).*
- *The shift in the nature of the climate of the earth caused by the greenhouse effects which is gradually heating up the globe, even melting ice caps in the arctic and antarctica (SP 38).*

These statements generally align with ideas expressed in the literature consulted on climate change and its causes, which includes the definition of climate as “the long-term weather patterns that describe a region” (Adedeji *et al.*, 2014:115), “change in either the average climate or climate variability that persists over an extended period” (Riedy, 2016) and “the average of different weather conditions at a certain point on the planet” (Sissakian *et al.*, 2022:13). Besides, “global climatic change has been recorded between the mid to the late 20<sup>th</sup> century due to increasing global temperatures as a result of human activities” (Amekudzi *et al.*, 2017:5; NRC, 2012:8).

Comparing the Phase 1 and Phase 2 responses showed that the number of students who expressed knowledge about climate change had increased significantly from 18 among the 75 students to 46 of the 90 students. The Phase 2 set of responses also showed better understanding of climate change in relation to the literature on the phenomenon than the responses that were given by the 18 Phase 1 students. This suggests the advantage that the group of 90 students enjoyed from the extensive exposure to climate change information as part of the gamified learning experiences in the design-led workshops versus the initial group of 75 students was significant. The level of knowledge expressed by the majority of the 90 students suggests the positive effect of the gamified learning experiences beyond what the initial 75 students expressed in their responses to the survey items.

#### **5.5.2.2 Knowledge of environmental sustainability matters**

At the initial stage of the study, 54 of the 75 Phase 1 students gave answers that touched on environmental sustainability. However, only the 18 students who expressed relevant knowledge on climate change also gave valid responses on environmental sustainability. Examples of statements the 18 student participants (coded SP) used to define environmental sustainability include the following:

- *Responsible interaction with the environment to manage the natural resources (SP 2).*
- *The maintenance of the practices that contribute to the quality of the environment on a long-term basis (SP 3).*
- *A means of protecting the environment (SP 23).*
- *The act of managing the natural resources so as not to deplete them for future generations (SP 26).*
- *A situation whereby the interaction with the environment doesn't cause depletion (SP 29).*
- *A responsible interaction with the environment to void depletion or degradation of natural resources and allow for long-term environmental quality (SP 31).*
- *It has to do with human activities that protect the environment (SP 32).*
- *The various ways in which we humans can help avoid the depletion or degradation of the earth's natural resources (SP 38).*

These ideas generally reflect the view of environmental sustainability as a means of “preserving the environment and the earth’s natural resources for the benefit of future generations” (Jones,

Hillier & Comfort, 2016:38–39). In particular, the responses that expressed environmental sustainability as “the ability to maintain the quality of the environment to avoid depletion of the natural resource” partly aligns with the idea of “preserving the environment and the earth’s natural resources to leave a legacy for the benefit of the unborn generations” (Dritz, 2014:7). This suggests that the 18 students were knowledgeable about the concept of environmental sustainability.

The concept of environmental sustainability showed up in 27 other responses related the concept of sustainability regarding *reforestation*, which is a recommended climate mitigation practice of planting trees and adoption of forestry practices that improve the plant cover on Earth to serve as carbon sinks to sequester carbon dioxide from the earth’s atmosphere (Reicken *et al.*, 2017:168-169; Amekudzi, 2017:9). In effect, 44 of the 75 Phase 1 students were knowledgeable about environmental sustainability even though not all of them could express their ideas as expected.

In Phase 2 of the study with the 90 students, environmental sustainability was defined in four clear ways as: *maintenance of the environment* (15 students), *putting in measures to protect the environment* (35 students), *renewing depleted resources* (18 students) and *maintenance of natural resources* (22 students). These Phase 2 second set of expressions show enhanced knowledge about environmental sustainability. Altogether, the ideas reflect the view of environmental sustainability as the “preservation, utilisation, responsible use of the earth’s natural resources and responsible use of the earth’s natural resources with the view of preserving them for the benefit of future generations” (Jones *et al.*, 2016:38–39). This knowledge implies a positive impact of the learning experienced from the gamified workshop activities that extended the students’ knowledge about environmental sustainability.

### **5.5.2.3 Familiar aspects of environmental sustainability**

The aspects of environmental sustainability that the Phase 1 group of 75 students reported as being familiar to them were *reforestation*, *waste recycling* and *sanitation*. The students who cited *reforestation* were 19 and formed roughly 25 per cent of the 75. Those who cited *waste recycling* were six (6) and two others cited *sanitation*. The responses given by the remaining 48 students showed definitions of environmental sustainability. *Recycling* and *afforestation* are indeed sustainability strategies that are being encouraged as a means to reduce excessive use of natural resources towards sustaining the environment (Reckien *et al.*, 2017:168-169; Whitehair *et al.*,

2013:65–68; National Research Council, 2012:28). This suggests that less than a half of this group of 75 study participants had adequate knowledge about environmental sustainability. The level of knowledge exhibited by this population of study participants justified their inclusion in this study. The scenario suggests that roughly one-third of this group of 75 students had some idea about environmental sustainability. The level of knowledge exhibited by this population of students justified their inclusion in this study.

During Phase 2 of the study with the 90 students that occurred after the gamified learning activities, 20 of them provided definitions of environmental sustainability instead of pointing out sustainability measures. The number of students whose responses aligned with the survey items cited the following measures: *renewing of depleted resources* (18 students), *maintaining the natural habitats* (22 students), *reforestation, mainly planting trees and grasses* (16 students) and *recycling of waste, mainly plastics* (14 students) as the aspects of environmental sustainability they were familiar with.

Interestingly, *recycling* and *reforestation* were found among the responses given by both the Phase 1 and Phase 2 group of students. These two elements are critical sustainability strategies that are being encouraged as a means of reducing the excessive use of natural resources as well as for improving the plant cover on Earth to replace the forest cover that has been destroyed, which will provide carbon sinks to sequester carbon dioxide and other greenhouse gases from the earth's atmosphere to sustain the environment (IPCC, 2012:42; Reicken *et al.*, 2017:168-169).

Some of the statements the study participants (coded SP) used to express their knowledge about environmental sustainability were the following:

- *Preserving the environment* (SP 5, SP 25).
- *Measures put in place to maintain or protect the environment from being destroyed* (SP 11, SP 14, SP 15, SP 21, SP 22, SP 60).
- *When the demand placed on the environment can be met without reducing the capacity for all people to live well* (SP 12).
- *Curbing the depletion and pollution of natural resources* (SP 17).
- *The act of ensuring and maintaining the good conditions of the environment and its inhabitants* (SP 29).
- *Measures put in place to ensure the environment is in its natural state* (SP 43).

- *Putting measures in place to sustain the environment (SP 39).*
- *One of the ways to help save the planet and our environment (SP 67).*

These responses generally reflect the view of sustainability as “taking action to preserve the environment and the earth’s natural resources to leave a legacy for future generations” (Dritz, 2014:7; Morelli, 2011:6). The responses also partly align with the idea of sustainability as “a continual process of actualising the possibility that humans and other life will flourish on the earth forever through consciously maintaining the balance between ecological, cultural, social and economic conditions” (Ehrenfeld, 2008:49 as cited in Reubens, 2010:12).

Comparing the two sets of responses makes it clear that the 70 Phase 2 students extended the idea of *reforestation* and *recycling* mentioned by 27 (out of 75) of the Phase 1 students to include *renewal of depleted natural resources* and *maintenance of natural (wildlife) habitats* (IPCC, 2012:42; Amekudzi et al., 2017:9). In effect, the number of students who provided valid responses increased from 27 (36%) in Phase 1 to 70 (77.8%) out of the 90 Phase 2 students after the intensive gamified learning activities. This increase of 43 “positively changed minds” attests significantly to the capacity of gamification as an experiential learning tool that is capable of engaging learners to focus attention and getting them to participate fully and be interested in the content to be learned, to solve problems and more generally, modify learner behaviour in desirable ways (Wunderlich *et al.*, 2020; Škuta & Kostolányová, 2016:423; Codish & Ravid, 2015). In this case, to impact behaviour positively towards developing “pro-environmental interest and open them up to change towards environmental sustainability” (Manzano-Leon *et al.*, 2021:11; Rajanen & Rajanen, 2019; Froehlich, 2015:3; Chung *et al.*, 2013).

The remaining 20 study participants (coded SP) gave various definitions of environmental sustainability such as stated here:

- *The process of trying to sustain the environment and make it a better place (SP 31).*
- *The way or means of keeping the earth healthy (SP 1).*
- *Making the environment better (SP 47).*
- *How some aspects of the environment are put in place to make it a better place (SP 37).*
- *How the environment is able to handle harsh or normal climate changes (SP 45).*
- *Measures taken to avoid or reduce the effect of climate change (SP 57).*
- *Increasing the capacity to cope with climate change and disasters (SP 59).*

These students' statements generally aligned with the concept of sustainability as "the process of creating and maintaining the conditions under which humans and nature can exist in productive harmony to fulfil the social, economic and other requirements of present and future generations" (Konchada, 2014:1; Reubens, 2010:12). It is surprising that climate change education as a practical sustainability strategy (Mochizuki & Bryan, 2015:5; Whitmee *et al.*, 2015:1973–1974; Gustafsson & Ijla, 2016:459; Anderson, 2012:193) did not appear in any of the Phase 1 and Phase 2 responses on this theme. Indeed, climate change education was the focus of the series of informal conversations, formal interactions on climate change and environmental sustainability, the design-led studio workshops and the artefacts that the students designed and created to demonstrate their learning of these issues over the two-day sessions and how they would help to sustain humanity and the flora and fauna the planet supports (Vardoulakis, 2015:299–300).

### **5.5.3 Sources of information on climate change and environmental sustainability**

There were options of combined sources of information on climate change and environmental sustainability that the students were required to select from to satisfy this theme.

From the responses given by the 75 Phase 1 students (see Table 5.1) who responded to this survey item, 69 or 92.0 per cent of them selected the TV/ Radio/ Newspapers/ Internet option of the responses. Moreover, Table 5.1 shows that the large majority (84 or 83.3%) of the 90 Phase 2 students selected this option of expected responses as the sources of their information and learning about climate change and environmental sustainability. The numbers show the advantage that these mass communication media (Hart & Feldman, 2016; Geise & Baden, 2015) offer as viable resources for communicating climate change and environmental sustainability information to educate people globally, including those in Ghana. It must be emphasised that these mass communication media provided vital resources in the form of images, videos, news items, and documentaries in relation to internet content to reinforce my conversation with the design students on the two concepts. The information we derived from such Internet sources were used to support the discussions on the two concepts as part of the gamified learning activities.

**Table 5.1: Sources of information for all study students**

<b>Sources of information</b>	<b>Phase 1 N=75</b>	<b>Phase 2 N=90</b>
Television/ Radio/ Newspaper/ Internet,	69 (92.0)	84 (93.3)
Specialist publications/academic journals Environmental groups (e.g., Wildlife Ghana)	30 (40.0)	21 (23.3)
School/ college/ university/ government agencies/ information services/ public libraries	24 (32.0)	47 (52.2)

The increase in positive responses on these media resources among the 90 Phase 2 students aligns with ideas on the power of imagery as influencing factors in positive behaviour change in the climate change discourse (Hart & Feldman, 2016; Geise & Baden, 2015). The implication is that these mass communication media can serve as tools for communicating information about the two concepts to educate the public in Ghana and thereby get people to behave responsibly towards the environment.

It is also significant to note from Table 5.1 that only 24 (32% out of 75) students selected the school/college/university/government agencies/information Services/public libraries option of the responses. These are avenues where students and the public can easily access readily available and relevant resources and information on the two concepts. Having only 24 of the 75 students select this option of expected responses confirmed my initial assertion that climate change and environmental sustainability issues are not prominent features of the school curriculum in Ghana.

Educational institutions in Ghana are known to have libraries that stock books and other educational resources to augment what the schools provide for teaching and learning of the various subjects that make up the national curriculum. The libraries are avenues where students and the public alike can easily access readily available and relevant resources and information on the two concepts. Moreover, school, college and university libraries are supported by the Ghana Library Board and the Information Services division of the Ministry of Information, which is responsible for communicating government policies and programmes to the public. Minority selection of this option may suggest the order of importance and availability of this source of

information as the means by which the students and the public are able to access information on climate change and environmental sustainability.

It is significant to note that the number of students who selected the school/college/universities/government agencies option as their source of information on climate change and environmental sustainability almost doubled from 24 out of 75 in Phase 1 to 47 (52.2% of the 90 Phase 2) study participants. This was after much knowledge had been shared through the gamified learning workshops, to raise the students' awareness and enhance their knowledge to the point where 23 more students recognised mass communication media as a viable source from which they could obtain information on the two phenomena. These "changed minds" suggests that the participating design educators and their colleagues could take advantage of this knowledge base to promote sustainability practices through their classroom and design studio lessons. These results also confirm the findings of Boakye (2015) and Boateng and Boateng (2015) that climate change and environmental sustainability are not prominent features of the school curriculum in Ghana.

Additionally, Table 5.1 attest to the specialist publications/academic journals/environmental groups option of expected response recording the least selection. The basis is that only 21 or 23.3 per cent of the 90 Phase 2 students in this HEI of technology reported accessing information on the two concepts from these educational resources. The number of participants who selected this option of the expected responses rather decreased from 30 in Phase 1 to 21 in Phase 2, which suggests a "negative change of mind" for nine of the students with regards to specialist publications/academic journals/environmental groups as accessible sources of climate change and environmental sustainability information that might even provide literature for graphic design pedagogy and learning.

Overall, it can be rightly assumed that the question-and-answer sessions that took place at the start of the gamified learning activities with the Phase 1 group of students, the online research that was conducted in relation to the climate change advocacy interactions and the group interactions improved the students' knowledge base on climate change prior to the design studio sessions. Thus, the gamified learning experience can be seen to largely account for the increase in rating the television/radio/newspaper/internet option of climate change and environmental sustainability information by most of the students in both groups. Consequently, the corresponding government organisations could work with educational institutions to offer training



programmes that would enable educators at the various levels of education to access the necessary resources to support climate change and environmental sustainability education in the classrooms. This would enable Ghana to infuse the school curriculum with the relevant topics so that more of the young citizens in school would be equipped with the relevant knowledge to increase their preparedness to mitigate climate change risks in their local communities.

In this regard, the recommendation to mainstream climate change education throughout the entire education system as an efficient means of tackling the climate change crisis (Stevenson *et al.*, 2017:1; Mochizuki & Bryan, 2015:8) can be implemented via game-based learning to inform more students in Ghana about climate change and environmental sustainability. The multiplier effect is the students being educated on the phenomenon in Ghana and sharing the knowledge with their friends, family and people in their communities and thereby motivating them to get involved in the fight against climate change effects at the local level (Mochizuki & Bryan, 2015:8).

#### **5.5.4 Interest in climate change and environmental sustainability**

The students' interest in climate change and sustainability issues were also assessed through the responses the selected students gave to this survey item. Five expected optional responses were used to identify what climate change and environmental sustainability meant to the students.

##### **5.5.4.1 Understanding of climate change**

Overall, 14 of the Phase 1 group of 75 students provided answers that touched on climate change only while 7 of them focused only on environmental sustainability. None of these 21 responses addressed the question adequately. Another set of 36 gave responses that were either unclear or unrelated to the expected answers. In effect, only 18 of the 75 students provided adequate responses that related to both concepts and reflected relevant literature on the two concepts.

Some of the statements that the 18 Phase 1 study participants (coded SP) used to express knowledge of climate change are the following:

- *A change in average weather conditions (SP 2).*

- *A change in global or regional climate patterns due to the increased carbon dioxide produced by humans (SP 4).*
- *The change of the climate over a long time (SP 55).*
- *Change of weather conditions due to global warming (SP 61).*
- *Change in weather patterns due to human activities (SP 29).*
- *Altered climate due to harsh conditions (SP 52).*

These expressions generally reflect aspects of literature on climate change such as a change in either the average climate or climate variability that persists over an extended period (Riedy, 2016) and the cumulative variations in climate statistics in a particular region over the course of years, decades, or centuries (NRC, 2012:1).

The remaining 57 (76.0%) participants provided responses that either showed little knowledge of both climate change (14 students) and environmental sustainability (7 students) or were unrelated (19 students) to both concepts. In addition, 17 others simply expressed their knowledge about the two concepts as “basic”, “a lot”, and “not very much”, or “no idea”, among others. The limited responses, which the majority (57) of the 75 Phase 1 study participants provided for this survey item justified their inclusion in the study.

In Phase 2, with the 90 participants, which took place at the end of the gamified workshop activities and learning experiences, the responses given related to the five options of responses that were specified in the questionnaire. Because the students had to tick as many options that applied to their understanding of climate change that were relevant, 350 responses were recorded for this item. In this sense, *change in climate due to human pollution* was selected by 68 or 75.5 per cent of the 90 students, followed by the option of climate change as *change in the environment* which was selected by 65 (or 72.2%) of the 90 students. However, those who understood the concept in terms of the *change in weather conditions* option numbered 37 and formed 41.1 per cent of the 90 students. In sum, roughly 75 per cent of the 90 study participants exhibited enhanced knowledge about climate change versus the group of 75 in the initial study.

Examples of the 54 valid articulations identified from the statements that were used by the Phase 2 study participants (coded SP) to define their knowledge about climate change include the following:

- *A change in global or regional climate patterns, which occurs when changes in the earth's climate system results in new weather patterns (SP 2, SP 35, SP 40).*
- *Change in the pattern of weather and related changes in oceans, land surface and ice sheet (SP 9).*
- *The change of weather conditions within a period of time at specific places (SP 27).*
- *It is the gradual abnormalities in weather conditions (SP 29).*
- *It is about the drift in normal climate patterns due to dangerous human activities (SP 57).*
- *The shift in the nature of the climate of the earth caused by the greenhouse effects which is gradually heating up the globe, even melting ice caps change is a state in which the atmosphere changes in temperature due to changes in the ozone layer (SP 38).*

These statements generally align with ideas expressed in the literature on climate change and its causes such as the shift in climate normal statistics that have been compiled in a given location over a period of a year and between a decade and the next (Amekudzi *et al.*, 2017:5).

The Phase 2 participants understood climate change in terms of the five options of responses. *Change in climate due to human pollution* recorded by 68 or 24.0 per cent of the respondents followed by *change in the environment* with 65 or 23.0 per cent of the total multiple responses. In effect, the participants in both studies expressed the meaning of climate change in relation to all the listed factors without any significant difference in their perception of the term *climate change*. From the Phase 2 responses, climate change as *change in weather conditions* scored the lowest of the responses. The 90 Phase 2 students also understood climate change in terms of the five options listed in the survey questionnaire.

Comparing the two sets of responses showed that the number of students who expressed adequate knowledge about climate change increased significantly from 18 (24% of 75 in Phase 1) to 46 (51.1% of 90 in Phase 2). The Phase 2 responses also showed better understanding of climate change in relation to the literature on the phenomenon versus the responses that were given by the 18 students. This suggests the advantage that the group of 90 students enjoyed from the gamified learning experiences and extensive exposure to climate change information as compared to the initial group of 75 students. The level of knowledge expressed by the 90 students suggests the positive effect of the gamified learning experiences beyond what the initial 75 students expressed in their responses to the survey items.

In effect, the students in both Phase 1 and Phase 2 of the study expressed the meaning of climate change in relation to all the listed factors without any significant difference in their perception of what the term *climate change* means. These responses align with ideas expressed in the literature on climate change such as “a change in either the average climate or climate variability that persists over an extended period” (Riedy, 2016) and “the average of different weather conditions at a certain point on the planet Earth where we are living. Typically, it is expressed in terms of expected temperature, rainfall and wind conditions based on historical observations” (Sissakian et al, 2022:13). Generally, these responses show a good understanding of the climate change phenomenon. This suggests that 80 per cent of the Phase 1 and Phase 2 group of students clearly understood climate change in terms of weather conditions while 76 per cent linked the concept to global warming, which the global community of scientists blame on human activities like modern farming, oil drilling and excessive global reliance on fossil energy in particular (Nicholls, 2016; Gustafsson & Ijla, 2016:459; Whitmee *et al.*, 2015:1973–1974).

#### **5.5.4.2 Participants’ knowledge about environmental sustainability**

The responses that touched on environmental sustainability only in Phase 1 with the 75 students were few. As has been indicated earlier in relation to climate change, only 18 of the responses given by the 75 Phase 1 study participants were considered valid for the purpose of this study based on their relationship with relevant literature on climate change and environmental sustainability. Examples of statements the 18 participants used to express their knowledge about environmental sustainability include the following:

- *Responsible interaction with the environment to avoid depletion or degradation of the natural resources and allow for long-term environmental quality (SP 2, SP 31).*
- *The situation whereby the interaction with the environment doesn’t cause depletion (SP 29).*
- *The means of protecting our environment for the future (SP 23).*
- *Human activities that protect the environment (SP 32).*
- *The ability to maintain the qualities that are valued in the physical environment (SP 39).*

The 18 responses generally reflected the concept of environmental sustainability as “preserving the environment and the earth’s natural resources for the benefit of future generations” (Reckien *et al.*, 2017; Jones *et al.*, 2016; Dritz, 2014; Morelli, 2011). In addition to this, 26 or 34.7 per cent

of the other respondents gave responses that related the concept of environmental sustainability to *reforestation*, which is a recommended practice for improving the plant cover on Earth (IPCC, 2014:42; Amekudzi et al, 2017:9). This suggests that these students had adequate knowledge about the concept.

In Phase 2, the 90 participants defined environmental sustainability in a much more refined way. Examples of statements the study participants used to express their knowledge of the concept are the following:

- *Maintenance of the environment* (15 students)
- *Putting in measures to protect the environment* (35 students)
- *Renewing depleted resources* (18 students)
- *Maintenance of natural resources* (22 students).

These Phase 2 expressions show enhanced knowledge about environmental sustainability. Altogether, the four related views reflect aspects of environmental sustainability in terms of “meeting the resource and services needs of current and future generations without compromising the health of the ecosystems that provide them” (Morelli, 2011:6). In effect, more of the Phase 2 participants’ responses showed ampler enhanced knowledge about environmental sustainability versus the responses deduced from the Phase 1 participants. The level of enhanced knowledge observed from the Phase 2 set of responses implies a positive impact of the learning experiences the study participants obtained from the gamified workshop activities that incorporated climate change and environmental sustainability concepts.

The scenario suggests the advantage the 90 Phase 2 participants enjoyed from exposure to the climate change information through conversation, study and discussion of climate change images, videos, text files and other online resources that were employed to draw the participants’ attention to the climate change phenomenon and how people can be encouraged to mitigate its impacts (Boon, 2016:1009). They had also been engaged in studio workshop activities that reinforced the message that resulted in this kind of enhanced learning that showed through these themes. The enhanced level of knowledge expressed by the 90 study participants suggests the positive effect of the gamified learning experiences on climate change beyond what the initial 75 participants expressed at the initial phase of this study.

### 5.5.4.3 Familiar aspects of environmental sustainability

For this item, 48 of the students' responses were definitions of environmental sustainability. Those who cited aspects of the phenomenon among the initial group of 75 study participants totalled 27. The aspects of environmental sustainability they mentioned were *reforestation* (20 students) and *recycling* (7 students) which are sustainability remedies that are being encouraged to maintain the environment. For example, designers must "consider the full life cycle of products and services and commit to strategies, processes and materials that value environmental, cultural, social and economic sustainability" (The Society of Graphic Designers of Canada, 2018). Similarly, Whitmee *et al.* (2015:1973-1974) and Gustafsson and Ijla (2016:459) recommend practical sustainability measures such as education to mitigate the looming toll of climate change to save the natural environment.

Statements the study participants (coded SP) used to express their ideas included the following:

- *Afforestation which means planting trees to replace the already cut down trees* (SP 5)
- *Changing from petroleum cars to electric cars to reduce emissions from them* (SP13)
- *Using renewable forms of energy and using recyclable materials* (SP 42)
- *Waste recycling* (SP 43)
- *Water preservation* (SP 44)

These responses show that roughly one-third of this group of 75 Phase 1 students knew a great deal about environmental sustainability. The level of knowledge exhibited by this population of students justified their inclusion in this study.

In the Phase 2 responses, the concepts of *renewing of depleted resources* (18 students), *maintenance of natural resources* (22 students), *reforestation, mainly planting trees and grasses* (16 students) and *recycling of waste, mainly plastics* (14 students) were the aspects of environmental sustainability the respondents were familiar with. Some of the statements the study participants (coded SP) used to express their knowledge about environmental sustainability are the following:

- *Measures put in place to maintain or protect the environment from being destroyed* (SP 11, 43).

- *The state in which the demand placed on the environment can be met without reducing the capacity to allow all people to live well (SP 12).*
- *The ways or means of keeping the earth healthy or in good shape (SP 1).*
- *Preserving the environment (SP 5).*
- *Measures put in place to control or reduce the effect of climate change (SP 23, 57).*
- *The effective maintenance of the environment (SP 19).*
- *The maintenance of the natural habitats (SP 10).*

Aspects of environmental sustainability were expressed as follows by the Phase 2 study participants (coded SP):

- *Activities to promote sustainable management of natural resources and eco-systems and integration of climate change and environment protection into development policies (SP 1).*
- *Afforestation and action against plastic waste (SP 27).*
- *Sustainable agriculture and sustainable forestry (SP 39).*
- *Eco-design, that is design that uses eco-friendly materials and bio-degradable substances (SP 28).*
- *Waste recycling (SP 43).*
- *Water conservation (SP 23).*

These expressions of the concept of environmental sustainability showed enhanced knowledge and understanding of the concept beyond the ideas expressed by the group of 75. The general idea presented here reflects the view of “striving to meet the needs of people, culture and business in a way that restores the planet and does not compromise our ability to meet the needs of future generations” (Dritz, 2014:7). They also extend to the view of sustainability as “the process of creating and maintaining the conditions under which humans and nature can exist in productive harmony to fulfil the social, economic and other requirements of present and future generations” (Reubens, 2010:12). These are truly relevant aspects that relate to the concept of environmental sustainability as outlined in the literature.

It is seen that the 70 Phase 2 students extended the idea of *reforestation* and *recycling* that the 26 students cited earlier to include *renewal of depleted natural resources* and *maintenance of natural (wildlife) habitats* (IPCC, 2012:42; Amekudzi et al., 2017:9). The number of students who

provided valid responses on environmental sustainability increased from 26 (34.7%) in Phase 1 to 70 (77.8%) in Phase 2 after application of the intensive gamified learning activities. This significant increase of 44 “positively changed minds” attests to the capacity of gamification as an innovative, *out-of-the-box* thinking (Glasser, 2007) and experiential learning strategy (Manzano-León *et al.*, 2021; Kapp *et al.*, 2020; Gündüz & Akkoyunlu, 2020; Deif, 2017; Kolb & Kolb, 2017) that can engage learners in a beneficial learning experience and get them to participate fully and be interested in the content to be learned, to solve problems and more generally, to modify learner behaviour in desirable ways (Subhash & Cudney, 2018:192; Sailer *et al.*, 2017:378; Dominguez *et al.*, 2013:381; Huotari & Hamari, 2012; Deterding *et al.*, 2011), in this regard, towards climate change and environmental sustainability (Rajanen & Rajanen, 2019:254, Mishra *et al.*, 2015:122).

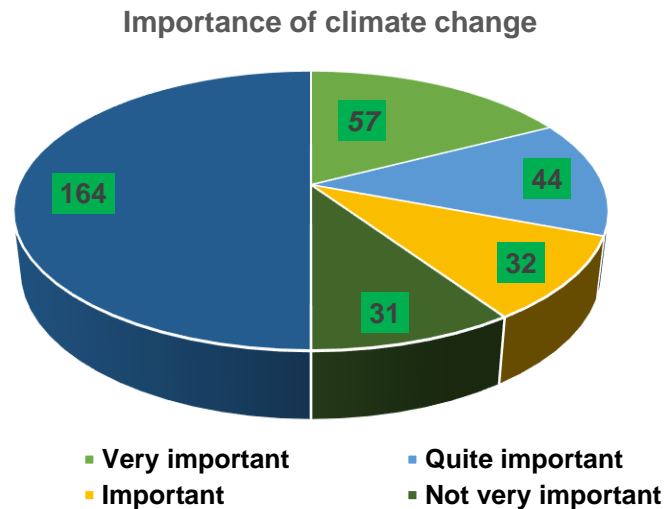
#### **5.5.4.4 Importance of climate change**

The rating of the importance of climate change by the 74 respondents varied from *very important* with a frequency of 10 (13.5%) responses to *quite important* with a frequency of 33 (or 44.6%) responses to *not very important* with 31 (41.9%) responses. This means that 43 or 58.1 per cent of the initial 75 students in the study considered climate change an important issue to discuss. It is, however, worrying that a significantly large proportion (31 or 41.3%) of the 75 respondents rated climate change as *not important*. This suggests a lack of awareness of the looming adverse effects of the climate change phenomenon because it is a threat to the very survival of humans, plants and animals on this earth (IPCC, 2018; Stevenson *et al.*, 2017; Vardoulakis *et al.*, 2015). These 31 students also seemed unaware of advocacy campaigns and research studies on the global stage that are urging people and governments to take action to help “protect and sustain the natural environment and save life on Earth” (Stevenson *et al.*, 2017; Nicholls, 2016).

The Phase 2 responses showed an improved rating of the importance of climate change as 47 (representing 52.2%) the 90 participating students rated the phenomenon as *very important*. This shows a significant increase from 10 or 13.3 per cent of the 74 students who rated the phenomenon as *very important* in Phase 1 of the study. It is also clear that none of the 90 students rated climate change *not very important* as 31 or 43.3 per cent of the earlier 74 students had done. Interestingly, 32 (or 35.6%) of them rated climate change *important* while 11 (or 12.2%) rated it *quite important*. In effect, 133 (representing 81.1%) of the 164 students who responded to this survey item understood climate change as *important to a large extent* (see Figure 5.3). The



data show significant and enhanced appreciation of the information and gamified learning activities that the 90 students were taken through in the Phase 2 of this study.



**Figure 5.3: Importance of climate change (2 studies)**

The fact remains that Ghana lies across three main ecological zones - the coastal south, the middle forest and the dry Sahel regions in the northern parts of the country (Kayaga *et al.*, 2020:4; MoFA, 2018; NCCAS, 2014:6). The majority of students who enter this HEI of technology in Ghana are normal residents of different parts of the country where environmental conditions and living experiences differ. Consequently, the differences in their experience of climate change in their respective locations in Ghana is likely to have influenced their responses to this survey item with respect to the importance of the climate change phenomenon. These responses could also not be validated after the study period.

The scenario here points out the significance of this study which responded to the call to expose the current and next generations of citizens to the considerable impact and consequences of climate change on the natural environment that is sustaining humanity (Mishra *et al.*, 2015; Whitmee *et al.*, 2015; McKeown & Hopkins, 2010). The fact that the graphic design industry has been cited as a contributor to environmental degradation (Grönman *et al.*, 2013; Janks, 2014) steered the study as it focused on creating awareness about environmental sustainability and climate change issues among these future designers so they would learn to care for the environment (Rajanen & Rajanen, 2019; Hu & Chen, 2016; Mishra *et al.*, 2015; Capstick *et al.*,

2015) and also adopt sustainable design practices to promote environmentally friendly products (BusinessVictoria.com, 2017; Dritz, 2014; Konchada, 2014).

#### **5.5.4.5. Causes of climate change**

The responses given to this questionnaire item showed that all 75 Phase 1 students had some idea of the causes of climate change. However, the only responses that had any connection with the graphic design industry were “lack of designs about the effects of climate change (SP 18) and excessive use of ink in design” (SP 25). Essentially, 64 per cent of the Phase 1 students perceived *human activities* as a cause of climate change. Indeed, “the world’s scientific community blames human activities, particularly, excessive global reliance [to drive industrialisation] on fossil energy for the climate change phenomenon” (IPCC, 2014; Gustafsson & Ijla, 2016:459; Gebreyes *et al.*, 2017:829-830). However, 21 or 28 per cent of the Phase 1 students identified climate change as a *natural occurrence*, which reflects the notion that “climate naturally changes over time; decades, centuries and Millennia” (Amekudzi *et al.*, 2017:5; Adedeji *et al.*, 2014:117; NOAAWS, 2007:2).

The responses given by the 90 Phase 2 students revealed both *pollution* and *human activities* as causes of climate change. The other causes of climate change recorded in the responses were *industrial activities*, *environmental change from natural occurrences such as volcanoes*, *illiteracy and ignorance*, as well as *deforestation*. Of these, *pollution of air, water and land from human activities* such as bush burning and illegal mining were cited by 19 or 25.6 per cent of the 78 students who responded to this survey item in Phase 2. The students who selected this optional response far outnumbered those who selected *pollution* (8%) in the Phase 1 responses. The number of students who perceived climate change as a *natural occurrence* also decreased from 21 (28%) in Phase 1 to 4 (or 5.1%) in Phase 2 which showed enhanced learning from the gamified activities.

Human activities, like bush burning, the release of gases from decomposed waste in landfills, the use of agricultural chemicals and illegal mining were cited among the possible causes of climate change in both Phase 1 and Phase 2 responses. From the responses, it was clear that the human factor in the warming of the globe which has led to climate change (Gustafsson & Ijla, 2016:459; Asante & Amuakwa-Mensah, 2015:6) had stuck in the minds of the Phase 2 students, resulting in a decrease of the selection from 48 in Phase 1 to 22 in the Phase 2 responses. *Deforestation*

as a cause of climate change was correctly identified by 13 or 16.7 per cent of the 78 Phase 2 students.

The students' views reflect literature on the role of human activities, including industrial set ups as the key source of "greenhouse gases and polluting emissions released into the earth's atmosphere since the beginnings of industrialisation in 1760" that have overwhelmingly affected the global climate (Whitmee *et al.*, 2015:1973-1974; Müller-Kuckelberg, 2012:2; Moldova, 2011:16), with the net result of "a 4 °C rise in the earth's surface temperatures over 100 years" (NRC, 2011a:8), which has led to climate change, "a critical environmental variable that has overwhelmed the earth and its ecosystem" (Asante & Amuakwa-Mensah, 2015:6; Müller-Kuckelberg, 2012:46; Ojala, 2012:625).

The two sets of Phase 1 and Phase 2 responses also pointed out that *lack of education on the causes of climate change* is what pushes people to resort to activities that contribute to the fast-changing climatic conditions. There is also *lack of advocacy campaigns* to educate and create awareness to make people aware of the situation to induce them to take responsibility for their behaviour towards the environment. These responses attest to the significance of this study as it sought to use educational gamification as an entertaining way to raise awareness about the risks and hazardous impacts associated with climate change as a phenomenon that "has direct consequences for life on Earth" (Mishra *et al.*, 2015:109–111; Boon, 2016:1009) and to also "promote hope in the young students and focus attention on graphic design as a viable pathway to a sustainable future" (Ojala, 2015:134). Hence, this study responds to the recommendation "to facilitate understanding of climate change risks, encourage judicious use of existing natural resources and positive attitudes and behaviour towards sustaining the natural environment" (Gustafsson & Ijla, 2016:459; Capstick *et al.*, 2015; Hu & Chen, 2016).

#### **5.5.4.6. Impacts climate change may have on the environment**

To answer this question, the study participants were required to tick all the options that applied to what they personally perceived as to how climate change impacts the natural environment. Those who interpreted the impacts of climate change in terms of the six elements (drought, flooding, rising temperatures, increasing intensity and frequency of extreme weather events, sea level rise and global warming) cited in the options of possible responses numbered 22 (representing 29.3%) of the 75 Phase 1 study participants. *Global warming* and *rising temperatures* were the two factors

that the majority (64 and 62 respectively) of the participants selected. The element that received the lowest selection was *sea level rise*.

Like the Phase 1 responses, *global warming* and *rising temperatures* were the two factors that the majority (79 and 73 respectively) of the Phase 2 students selected as the climate change factors that may have the most significant effect on the environment. Similarly, the element that received the lowest selection is *sea level rise*. Overall, the answers provided to this question showed that all the Phase 1 and Phase 2 study participants had an idea of what the effects of climate change were.

The students in both groups correctly identified the effects of climate change as *pollution due to human activities* (13), *rising temperatures and extreme weather conditions* (11), *deforestation* (14), *drought and flooding* (17), which were the predetermined responses indicated in the survey item. However, the Phase 2 responses revealed marked increases in the selection of all six expected options. For example, *global warming* and *rise in temperature* recorded 79 and 73 responses respectively while *sea level rise* recorded the lowest of 40 responses. The 90 Phase 2 students therefore showed a better understanding of the climate change effects identified in the literature on the phenomenon.

#### **5.5.4.7. Climate change impacts that will affect Ghana (multiple responses)**

Of the six climate change impacts, 30 (or 30.5%) of the Phase 1 responses pointed to *global warming* as the impact of climate change that will mostly affect Ghana. In addition, 26 (or 26.0%) other responses pointed at *rising temperature*. In the case of Phase 2 with the 90 participants, *rising temperatures* and *global warming* recorded 43 (or 30.7%) and 31 (or 22.1%), respectively, of the total responses. The responses suggest these two factors as the climate change impacts that will affect Ghana the most. This means the respondents found the two elements more relevant to Ghana's situation while *sea level rise* was judged the least significant consequence of climate change to affect Ghana. These responses reflect literature on climate change impacts on Ghana, particularly in the dry northern regions (IGGS, 2015; NCCAS, 2014; Asante & Amuakwa-Mensah, 2015; Amekudzi, 2017).

As to the entities that would be most affected by climate change impacts in Ghana, the general perception showed that *humans and other living organisms* in Ghana would be mostly affected

by the effects of climate change. *Humans and other living organisms* recorded 65 or 79.3 per cent of the responses. The responses recorded from Phase 2 with the 90 participants also had the same elements with *everyone living in the country and living organisms* scoring 70 or 77.8 per cent of the responses. The implication is that climate change will affect everyone in the Ghanaian society, including the economy and the natural environment. This view reinforces the idea of climate change as “the most urgent and far-reaching environmental issue that has affected the socio-ecological health of the natural environment in the coming decades” (Reckien *et al.*, 2017; Hu & Chen, 2016; Vardoulakis *et al.*, 2015; Ojala, 2012). It also justifies the IPCC’s announcement that “the scientists have reached the global consensus that there is an urgent need to act to overcome the social and environmental impact of climate change” (IPCC, 2014, 2018).

#### **5.5.4.8. Awareness of climate change campaigns in Ghana**

On whether the students had observed any climate change awareness campaigns going on in the country, the item recorded 49 or 65.3 per cent “Yes” and 26 or 34.6 per cent “No” responses that were given by 72 of the 75 Phase 1 students. This implied the occurrence of climate change awareness campaigns in Ghana at the time of data collection. In contrast to this, an increased number of 56 (or 64.4%) of the 87 students who responded to the survey item in Phase 2 indicated climate change awareness campaigns were not being carried out in the country. Those who confirmed this awareness totalled 31, forming 35.6 per cent of the total number. The increased number of “No” responses given by the 87 Phase 2 students reflect enhanced awareness of climate change issues deduced from the online literature and related media resources that the students accessed as part of the gamified learning activities.

The interactions on climate change and environmental sustainability and the time the students spent watching and discussing relevant videos and images gathered from various parts of the world obviously gave them a better understanding of the phenomenon and the reality of climate change advocacy campaigns became clear to them. What the students learned from the brainstorming sessions and sharing of personal experiences of climate change in Ghana as part of the gamified design-led activities are likely to have heightened their awareness and induced this change of mind about the concept of advocacy campaigns against climate change impacts, in relation to this survey item.

The next level was to find out if climate change awareness campaigns were happening at the university in the study at the time of data collection. With regards to this item, the majority (48, or 66.7%) of the 72 Phase 1 students who responded to this survey item stated *No*, to indicate the absence of any climate change awareness campaigns. There were 12 “Not enough” and “Not sure” responses with the same number of “Yes” responses. In effect, those who confirmed awareness of climate change campaigns in the university numbered only 16 and formed 22.3 per cent of the students who responded to the item. Two students reported sighting awareness campaigns as part of exhibitions and class assignments respectively. One “gold nugget” of a response was “Not to my knowledge. Trees are even being cut down in my university in the name of giving aesthetic features to the university” (SP18). This suggests awareness of happenings that are not pro-environment on the campus.

Other expressions that the Phase 1 study participants (coded SP) used to communicate this perception are the following:

- *Yes, but I believe not everyone is exposed to the campaign* (SP19, SP29, SP37).
- *Yes, but more effort is needed in the campaigns to fully attract our attention* (SP30, SP31).
- *Yes, but they are not consciously and systematically planned. This makes the awareness ineffective* (SP33).
- *Yes, there has been more awareness on climate change on the radio, television and Facebook* (SP3).
- *Climate change awareness campaigns are poorly carried out* (SP24).

The students who reported being unaware of climate change campaigns in the HEI addressed in the study numbered 48 and represented 66.7 per cent of the 72 Phase 1 students. Those who said “Yes” to show awareness of such climate change advocacy campaigns numbered 24. Having a majority (48) of the 72 students reporting unawareness of climate change awareness campaigns suggests the need for this study. This gap is what the study aimed to address as it provided the opportunity for the selected graphic design students to be informed about climate change and environmental sustainability.

One other response that I considered invaluable was given in relation to “*causes of climate change*” but which rather fits this context, is this statement: “We do not hear about climate change and how they go about informing us is not done seriously enough; the informers make it look as

if they [causes of climate change] are normal occurrences; they do not hit strongly on the damages and destructions climate change brings to the environment. Persuading consumers is just very poor” (Phase 1, SP 74). This perception also justifies this study as a credible approach to climate change and environmental sustainability education from the graphic design perspective.

Analysis of the responses given to this survey item in Phase 2 revealed a lack of awareness of climate change campaigns in the HEI by 71 or 78.9 per cent “No” responses to indicate that climate change awareness campaigns were not being carried out in the HEI under scrutiny. The number of “Yes” responses were 12, forming 13.3 per cent of the 87 students who provided responses to this survey item. With 78 (including “Yes, but not enough”) Phase 1 students denying awareness of climate change campaigns in the university implies they may not have considered the gamified learning experiences as part of such advocacy activities.

Both phases of the study, however, confirmed the lack of climate change awareness campaigns in the local context, regarding the country as a whole and this higher education institution in particular. The call then is for the design educators to continue this climate change awareness campaign by incorporating environmental sustainability into their lessons in order to extend this learning to all their students. Heightened awareness may motivate the students to seek more information about climate change so that they can adopt sustainable design practices to extend the knowledge of sustainability to a greater number of the design students and educators in the university.

#### **5.5.4.9. Schools teaching about climate change**

The responses showed that 40 or 55.6 per cent of the 72 Phase 1 students answered “Yes” to confirm that schools in Ghana teach their students about climate change. This response runs contrary to the findings made by Boakye (2015) and my initial assumption that climate change education is not a prominent feature of the school curriculum in Ghana. The students who said “No” totalled 23, and nine (or 12.5%) others were not sure the schools provide this service in the country. Those who said “climate change is taught in the schools but the service does not adequately educate” them about the phenomenon numbered 17 and formed 22.7 per cent of the 75 Phase 1 students in the study. The “No” responses numbered 21 and formed 28 per cent of the responses. Having 21 “No” and 17, or 25 per cent “Not sure” responses suggests no or inadequate teaching about climate change in some of the schools these study participants attended. The scenario reflects Boakye’s (2015) finding that climate change is not effectively

taught in all of Ghana's schools. This suggests that Ghana's Climate Change Education in Schools programme that was launched in 2014 (IGGS, 2015:24; NCCAS, 2014:6; Yaro *et al.*, 2015:235) was not being implemented effectively.

#### **5.5.4.10. "I was taught about climate change"**

This survey item sought to know if the students in the study had prior learning about climate change in their previous schools before attending the university or not. The responses gathered revealed that, 30 or 44.1 per cent of the 75 students were taught about climate change. This number of "Yes" responses further indicate that climate change as a topic is taught from primary school through senior high school to the university level. It is taught to students who study environmental science, geography, biology and social studies.

In Phase 2 of the study, some of the students said "climate change as a topic is taught in primary and secondary schools, but that it depends on the programme one is studying". Two other students said the subject was taught but not in detail. This means the topic is taught as an academic subject and not as an important environmental issue to be addressed or educate people about. Only 11, or 14.9 per cent of the students answered "No" to suggest that they were not taught about the phenomenon. The scenario highlights the lack of climate change education for students in Ghana who do not study social studies or science. This points to the significance of the study, particularly in a visual arts context.

Additional information that was provided in nearly all the responses that said "Yes" was that geography and biology were the subjects through which they were taught about climate change in the senior high schools. This reflects the idea of McKeown and Hopkins (2010) that climate change education is typically provided through geography and science disciplines. This study therefore afforded the graphic design students an equal opportunity to learn about the climate change phenomenon, particularly those who attended senior high schools that did not teach this topic. The results reflect the idea that very few courses in higher education institutions even teach about climate change (Boateng & Boateng, 2015). It is important that the Ministry of Education ensures that the schools teach about climate change because sustaining the natural environment has direct consequences for the survival of life on planet Earth (IPCC, 2018; Vardoulakis *et al.*, 2015; Boon, 2016).



#### 5.5.4.11. Measures exist to tackle climate change

The question of whether the Phase 1 students knew of anything that could be used to tackle climate change recorded 46, or 63.0 per cent “Yes” and 27, or 37.0 percent “No” responses from the 73 respondents who answered this survey item. All the students called for awareness campaigns to be mounted to educate the public on climate change and environmental sustainability impacts in Ghana. It can be argued that the students believed it was possible to deal with climate change.

The 46 Phase 1 positive responses meant something could be done to tackle the occurrence of climate change. Similarly, the Phase 2 responses for “Yes, something can be done to tackle climate change” totalled 76, and represented 89.4 per cent of the 90 participants. Thus, a greater percentage of the students believed something could be done to tackle climate change at both stages of the study. These responses reflect the call for people and governments to take action to help protect and sustain the natural environment to save life on Earth (Stevenson *et al.*, 2017; Nicholls, 2016; Kahan *et al.*, 2011).

The 36 “No” responses recorded in Phase 1 and Phase 2 suggest that these students had not been affected by the conversations, discussions, online images and information that was shared on climate change during the gamified learning activities and the design workshops.

Explanations that were added to some of the “Yes” responses in both phases of the study include the following expressions by some of study participants (coded SP):

- *Human activities and ignorance of people contribute significantly to the changing of the climate and therefore raising awareness of the people/public would help actors to institute pragmatic measures to curb the situation (SP 63).*
- *Public educational programmes on the climate change menace, practices that cause climate change, negative effect of climate change, etc. can be facilitated using social media platforms, television, radio, posters (SP 35).*
- *Encouragement of afforestation like planting of trees and grass, recycling of plastic waste, etc. (SP 14).*

Some of the responses mentioned the need to apply the laws of Ghana to regulate or sanction industries that pollute the environment. Such comments resonate with the need to enforce the numerous agreements and laws that have been passed to regulate human activities such as mining, drilling, producing, polluting, consuming, trashing and burning (Vardoulakis *et al.*, 2015).

#### **5.5.4.12. Climate change impacts on the environment**

To answer this question, the students were required to tick all the options that applied to what they personally perceived as to how climate change impacts on the natural environment. Those who interpreted the impacts of climate change in terms of the six elements (drought, flooding, rising temperatures, increasing intensity and frequency of extreme weather events, sea level rise and global warming) cited in the expected responses, numbered 22 (or 29.3%) of the initial 75 Phase 1 students. *Global warming* and *rising temperatures* were the two factors that the majority (64 and 62 respectively) of the students selected.

Like the Phase 1 responses, *global warming* and *rising temperatures* were the two factors that the majority (79 and 73 respectively) of the 90 students in Phase 2 selected as the climate change impacts that affect the environment the most. Similarly, the element that received the lowest selection is *sea level rise*. Overall, the answers provided to this question showed that all the students had an idea of what the effects of climate change were, in line with the literature on climate change (Reckien *et al.*, 2017; IPCC, 2014; Kim *et al.*, 2013; NRC, 2012; Pender, 2010; CIGI *Special Report*, 2009; Amekudzi *et al.*, 2017; NOAAWS, 2007).

#### **5.5.4.13. Entities in Ghana that climate change risks will mostly affect**

The general response showed that humans and other living organisms in Ghana will mostly be affected by the effects of climate change. The two elements recorded 65, or 79.3 per cent of the responses. The responses recorded from Phase 2 with the 90 students also had the same elements with everyone living in the country and living organisms scoring 70, or 77.8 per cent of the responses. This view reinforces the idea of climate change being a huge threat to the natural environment and the flora and fauna it supports in on Earth (Vardoulakis *et al.*, 2015; Ojala, 2012).

#### **5.5.4.14. Personal changes to minimise effects of climate change**

Only 14 of the responses given by the 66 students who answered this survey item focused on personal changes they were willing to make to increase their preparedness to minimise the effects of climate change. They were willing to change their attitudes to climate change issues. Eighteen of them would use design to educate others and 16 would join a campaign team. Some of the personal actions that were expressed in the 14 statements were the following:

- *As a designer, I will be willing to change my ignorant attitude to climate change* (SP16, SP23, SP31).
- *I will stop everything that serves as a catalyst to climate change and educate people who come my way* (SP16).
- *I will be mindful of the materials I use* (SP10, SP11, SP15).
- *Recycle our waste* (SP1, SP8, SP13).
- *Stop littering* (SP55).
- *Use less ink for design* (SP7).

These are valid personal actions that can be encouraged. The responses that were given by the 66 Phase 2 students were similar to those provided in response to the survey item by the initial group of 75 Phase 1 students. *Change my ignorant attitude*, which was indicated in 14, or 21.2 per cent of the 86 total responses, was the most personal response that was given overall. Again, the expected personal touch was absent from the responses.

#### **5.5.5 Designers' contribution to climate change and environmental sustainability**

Generally, 65 of the Phase 1 responses reflected the design of products such as posters, advertisements, billboards, videos, documentaries, banners, flyers and T-shirts to create awareness and educate the public on climate change and environmental sustainability. One of the 75 Phase 1 students said, "Designers do not play any role in contributing to climate change and environmental sustainability". This assertion implies lack of awareness of the fact that the graphic design industry largely depends on natural resources like water and paper to produce what humanity needs.

The responses that were provided by the 73 Phase 1 students who answered this survey item did not link the graphic design industry with extensive use of natural resources such as water and paper produced from wood to generate the products and services that humans need (Konchada, 2014; Dritz, 2014). They also did not connect it with graphic design products and the non-biodegradable waste it causes to pollute the environment. Others further did not link graphic design to its capacity to generate sustainable solutions that the environment needs with its non-biodegradable products (Yu & Sangiorgi, 2014:195-199; Grönman *et al.*, 2013:187–189). The industry therefore forms part of the environmental degradation problem as the products it generates from metals, plastics and other materials are often non-degradable and contribute to the waste that pollutes the environment (Konchada, 2014; Grönman *et al.*, 2013; Manzini, 2007).

The 109 multiple responses given to the survey item by 82 of the 90 Phase 2 students focused on the use of design to create awareness campaigns for public education on climate change and environmental sustainability. The results in Table 5.2 show an almost equal number of those who believed in the use of design as a means of communication to create awareness campaigns on the two concepts.

**Table 5.2: How designers contribute to climate change and sustainability (multiple responses)**

<b>Response</b>	<b>Phase 1</b>	<b>% of responses</b>	<b>Phase 2</b>	<b>% of responses</b>
Design	46	38.7	44	40.4
Education	13	10.9	22	20.2
Awareness campaign	43	36.1	43	39.4
Creating medium of communication	9	7.6	0	0
Innovation	8	6.7	0	0
<b>Total</b>	<b>119</b>	<b>100%</b>	<b>109</b>	<b>100%</b>

The following are some statements by the study participants (coded SP) on this matter:

- *By designing billboards, posters and making/creating awareness through advertising and social media (SP1, SP11, SP23).*
- *By communicating with visuals and audio-visuals to create awareness to the public (SP 51, SP55).*
- *Create an awareness campaign which will stick in the minds of people to help avoid the causes (SP 7, SP33, SP65).*
- *Create awareness by applying our knowledge in design and how to make our voices heard (SP33, SP42).*

The students' responses were expected to focus on the use of water, paper, ink and other graphic design raw resources that are derived from the earth's natural environment that leads to deforestation and pollution. Instead, the responses cited design outcomes as designers' contribution to climate change and environmental sustainability.

#### **5.5.5.1. How designers can help curb climate change**

Eight (or 10.7%) of the 75 Phase 1 students said "No" to suggest they were not aware of anything designers can do to help curb climate change. The other responses, including 33, which cited commercial adverts, rather cited the designing of products for use in awareness creation campaigns. The "personal involvement" aspect in the question was not seen in the responses, probably because they were not sure what they could do as student designers. Answers to the previous question were rather fit for this question and vice versa.

The 90 Phase 2 students indicated that they were aware of the things to do to curb this issue. From the results, 59, or 74.7 per cent of the 79 respondents said they were aware of things they could do to curb the climate change issue. However, 25 per cent of them indicated "there is nothing that could be done to solve the climate change problem". These students had probably not paid attention to the mitigation strategies and the ways in which design can be used to communicate information on climate change as well as support environmental sustainability.

#### **5.5.5.2. Suggested designers' actions to sustain the environment**

The respondents were unable to provide the expected answers for this open-ended survey item. The suggestions to solve the problem of climate change in order to sustain the environment

focused on the use of designs. These ideas were expressed in statements like the following by the study participants (coded SP):

- *Design and use posters, videography, pictures or graphical imagery, T-shirts, banners, flyers, among others to create awareness and educate the people around them about the climate change issue (SP 13, SP 35, SP 41).*
- *Designers should come out with campaign projects, a short documentary for publication, commercial TV programme to create awareness. A unified campaign which designers can easily pitch in with their work with a focus of a central theme (SP 16, SP 11, SP 44).*
- *Use videos to communicate to the public on the cause, effect and suggest how to minimise activities that cause climate change (SP 66).*
- *Create animated videos that will state the causes and effects of climate change. Also, the video will suggest how to minimise activities that cause climate change (SP 3, SP 15).*

## **5.6. Chapter summary**

It is evident from the discussion and analysis that the selected graphic design students' learning context and the views they expressed about climate change and environmental sustainability changed significantly after the gamified design-led workshop learning activities described in Chapter Four, which also forms the basis of this chapter. The narrations clearly show the level and depth of the students' knowledge, experiences and thinking about climate change and environmental sustainability in relation to how design practice and the graphic industry contributes to environmental degradation as well as how it uses its many tools and "designerly" ways to promote sustainable living.

Interpretation of the data and findings presented in this chapter also reflect the mindset of the students with respect to the survey that sought data through a questionnaire at the initial stage with the group of 75, the observations done during the gamified design-led workshop activities and learning experiences and the responses that were derived from the second questionnaire administration at the end of design-led workshop activities.

The gamified learning strategy that was employed for the research both raised awareness and clarified the climate change concept to enable the students to perceive the phenomenon as "very important" and a critical factor in the survival of humanity on planet Earth (Reckien *et al.*, 2017;

Gustafsson & Ijla, 2016; Vardoulakis *et al.*, 2015). Of mention, is the fact that the number of students who rated climate change “Very important” increased significantly from 10 (13.3%) in the first study to 47 or 52.2 per cent in the second study. Unlike the 31, or 43.3 per cent of those who rated climate change “Not very important” in Phase 1, all 90 (100%) Phase 2 students considered the phenomenon “Important”. Hopefully, the students will serve as change agents to adopt responsible behaviours towards the climate change phenomenon and its associated risks.

The discussion reiterates the point that climate change and environmental sustainability education are not prominent features of the Ghanaian school curriculum, including higher education (Boakye, 2015; Boateng & Boateng, 2015). Similar to the study conducted by Chung *et al.* (2013), gamification has been successfully applied to show the “capacity of game-based learning to motivate and engage students to participate fully in learning tasks and be interested in the content, which is a major challenge in the field of education” (Manzano-León *et al.*, 2021:11; Subhash & Cudney, 2018:192; Dichev & Dicheva, 2017; Dominguez *et al.*, 2013:381; Lee & Hammer, 2011). As a tool for teaching and learning about environmental sustainability and climate change within the context of higher education in graphic design, gamification with its exciting way of learning inspired the graphic design students to develop pro-environmental interest and opened them up to acceptable user behaviours (Wunderlich *et al.*, 2020; Rajanen & Rajanen, 2019; Alsawaier, 2018; Ro *et al.*, 2017:21; Sandusky, 2016; Froehlich, 2015; Deterding *et al.*, 2013), in this research case, towards sustainable design practice. The *green gamification* and design approach enhanced the process of conveying the abstract concepts of environmental sustainability and climate change to the selected undergraduate graphic design students and also their learning experiences (Caponetto, Earp & Ott, 2015:55) towards sustainable design practices to advocate environmental sustainability.

It is clear that gamification can “bring climate change communication to a new level by harnessing the individuals' abilities and interests through well designed technological affordances” (Rajanen & Rajanen, 2019:254). Gamification can also promote healthy competition and teamwork, boost motivation and engagement, and because the students like games (Škuta & Kostolányová, 2016:427; Pho & Dinscore, 2015; Kalinauskus, 2014; Johnson *et al.*, 2014), they would appreciate gamification application in their design lessons if their educators used them.

The final summary, conclusions and recommendations of this research study are provided in Chapter Six.

## **6. CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

This chapter revisits the research problem and the research questions aimed at achieving the research objectives outlined earlier in Section 1.5. Furthermore, it delineates the contributions of the study. After providing a summary, it draws significant conclusions and offers recommendations. This information emanates from the analysis and discussion of the findings that reflect the selected graphic design students' ideas and perceptions about climate change and environmental sustainability as indicated in Chapter Five of the study.

### **6.1. The research problem**

The research problem this study investigated was: to explore gamification as a pedagogical tool to enhance graphic design students' engagement with climate change and environmental sustainability to support the related behaviour adaptation and change within the Graphic Design curriculum offered at KNUST, Ghana.

Although much has been published concerning gamification itself, there remains a limited number of publications concerning gamification as a pedagogical tool to promote an understanding of climate change and environmental sustainability in a university of technology. This study addressed this noted gap in the body of knowledge.

### **6.2. Research questions**

This section addresses the research questions outlined earlier in Section 1.4. The main research question is repeated here for convenience.

**MRQ:** How might gamification be integrated into design pedagogy to enhance graphic design students' engagement with environmental sustainability within the context of an HEI in Ghana?

The main research question (MRQ) gave rise to two sub-questions – SQ1 and SQ2, addressed severally below in Section 6.3. The answering of the two sub-questions provides an answer to the main research question.



### 6.3. Research sub-questions

**SQ1:** What design-related game mechanics could be employed to enhance graphic design students' engagement with environmental sustainability praxis within the context of an HEI in Ghana?

Gamification and its mechanics of badges, levels and leaderboards are necessary tools that can conveniently be applied with visual design methods such as videos, illustrations, photographs, drawings, and storytelling to break the complex climate change information into simple ideas that can be easily understood by students.

Game-based learning strategies such as *Kahoot* and *30 Seconds* were applied to extend climate change and environmental sustainability education to students in secondary schools, colleges and universities. Google and YouTube images and videos on climate change and sustainability are additional resources. Yu-kai Chou's Octalysis gamification framework (Chou, 2012; Majoor & Eliens, 2012) was the conceptual model for the study. The Octalysis served as a lens to inform the design of the study participants' gaming experience as well as to analyse the outcome of the research. It further served as an analytical tool to assess the students' learning as well as the design projects they initiated and artefacts they created in response to critical environmental issues in Ghana.

This was done in the context of three Octalysis core drives: Epic meaning and calling; Development and accomplishment; Empowerment of creativity and feedback in *White hat gamification*. These are the emotional drives of the Octalysis framework that emphasise the emotional aspects of gamification. These drives made it possible to integrate the human aspect of gaming into the design and development of the gamified learning experiences. The gaming concepts that were utilised in designing the gamified learning experiences regarding environmental sustainability in the context of graphic design education were Rapid feedback, Flow and Leaderboards. These represent the mechanical, emotional and personal aspects of gaming.

**SQ2:** How could gamification as an instructional tool enhance the understanding of the abstract notion of environmental sustainability within the context of design education?

Gamification, which is an experiential learning approach (Deif, 2017), and design-led workshop activities were designed and applied to develop a gamification framework that could guide the teaching of environmental and sustainable design practices within the selected HEI context. Gamification as a teaching tool inside the non-gaming framework of design education made it possible to test the students' perceptions on issues relating to environmental sustainability and climate change.

The answering in this section of the study of SQ1 and SQ2 and thus MRQ1 culminates in the indication that the objectives of the study Q1 and Q2, set out earlier in Section 1.5, have been met.

#### **6.4. Contributions of the research**

The study was conducted to inform design educators about game mechanics that can be adapted as foundational blocks and tools to enhance the teaching and learning of design. This was specifically with the view to conveying concepts of environmental sustainability and climate change to a younger generation of designers through educational gamification. The study responds to the fact that Ghana as a developing economy largely depends on rain-fed agriculture and is, therefore, highly vulnerable to climate change impacts (Kayaga *et al.*, 2020:3; MoFA, 2018; Asante & Amuakwa, 2015; Arndt *et al.*, 2015; Pisano *et al.*, 2015) yet has neither fully promoted environmental sustainability or climate change issues in the educational system and to the public at large (Boakye, 2015; Boateng & Boateng, 2015). Climate change and environmental sustainability have also not been properly integrated into graphic design education in higher education institutions (HEIs), secondary or primary schools. In this regard, graphic design educators and their students in the Department of Graphic Design in the selected HEI of technology in Ghana, comprised the population studied.

It is critical that Ghana implements the National Climate Change Education programme that was launched in 2014 (IGGS, 2015:24; NCCAS, 2014:6; Yaro *et al.*, 2015:235), starting in schools, to raise awareness about climate change and sensitize the citizens to appreciate the consequences of deforestation, land degradation and pollution of water bodies, through illegal logging and mining, essentially to save the natural environment to prevent desertification and the risk of food, water, health and well-being of the people (Kayaga *et al.*, 2020; Danyo & Osei-Bonsu, 2016:113; Asante &

Amuakwa-Mensah, 2015:6; Ocansey, 2013; Müller-Kuckelberg, 2012:46; Yaro, 2010) and leave a legacy of natural resources for future generations. Gamification can be adapted for this purpose.

#### **6.4.1. The theoretical contributions**

This study was situated within the constructivist research paradigm (Terrell, 2016; Creswell, 2014) and was conducted using gamification, an experiential learning approach (Deif, 2017). Gaming is being implemented in many educational programmes, which are non-gaming contexts, to “help educators find the balance between achieving their objectives and catering to evolving student needs” (Pho & Dinscore, 2015:1–2). Gamification has proved to be a viable tool that can be used to re-model traditional classroom education (Sandusky, 2016:1–5; Biro, 2015:150; Kiryakova *et al.*, 2013:1–2;). Game mechanics are also “increasingly being used by companies to provide ‘rewards for making good, green choices’” (Conaway & Garay, 2014; Joel, 2013:9; GreenBiz Group report, 2012). However, gamification and its potential for educational purposes has not been fully explored in Ghana. Gamification was adopted in this study as a pedagogical tool to promote environmental sustainability thinking in graphic design education as a way of promoting green gamification. The study also investigated gamification as an alternative strategy for addressing climate change problems through design education in Ghana.

This strategy essentially aimed at exposing the “current and next generations of citizens to the significance of climate change and its impact on the environment” (Mishra *et al.*, 2015:122) in an enjoyable way of learning via “well designed technological affordances” (Subhash & Cudney, 2018; Dichev & Dicheva, 2017; Sailer *et al.*, 2017; Andrade, 2016; Al-Azawi *et al.*, 2016; Bíró, 2014) so they would design environmentally friendly products and services. The aim was to encourage the students to develop positive values towards the environment (Manzano-León *et al.*, 2021; Rajanen & Rajanen, 2019; Ro *et al.*, 2017:21; Whitmee *et al.*, 2015). Gamification was adopted because “fun is the easiest way to change people’s behaviour for the better” (Kim, 2015:16).

The study was underpinned by the experiential learning theory mainly because “effective learning that transforms experiences demands that the learner goes through the entire cycle of concrete experience with abstract conceptualization, reflective observation and active experimentation” (Kolb & Kolb, 2017:8; Jose *et al.*, 2017:6). Thus, “active learning” approach reflects the Chinese proverb “I hear and I forget, I see and I remember, I do and I understand” (Confucius, 551 BC-

479 BC in Hawtrey, 2007:144) and supports graphic design education and professional practice (Snaddon *et al.*, 2019; Debrah, 2020; Appiah, 2014; Motley, 2017; Boling *et al.*, 2016).

The conceptual model that was selected for the study was Yu-kai Chou's Octalysis gamification framework (Chou, 2016; 2015; 2012; Majoor & Eliens, 2012). This is because it elaborates what drives those who play games and the drivers that enable the games to achieve the purpose for which they are designed and what they are intended to do, which is, engage the user. Three core drives in *White Hat* gamification were applied because they focus on the positive side of gamification. These three Octalysis core drives were *Epic meaning and calling*, *Development and accomplishment*, and *Empowerment of creativity and feedback*. Selecting *white hat* gamification made it possible to integrate the human aspect into the design and development of the gamified learning experiences. The Octalysis framework served as a lens to inform the design of the study participants' gaming experience as well as to analyse the outcome of the research. The three core drives also served as the framework to categorise the data obtained from the graphic design students' perspective for analysis and to assess the students' designed artefacts on environmental sustainability. The Octalysis framework served as a guide to reveal emerging features of gamified learning experiences from the students' perspective.

#### **6.4.2. Methodological contributions**

The research was design related so visual-based design methods such as photographs, audio and video recordings, storytelling and brainstorming in design-thinking workshop activities (Heather & Walters, 2016:40-42; Nova, 2015:19-22; Gray & Malins, 2004:72) were largely used for data collection. Due to the human centredness of gamification, the study was conducted with a purposive sample of undergraduate graphic design students and design educators in an HEI of technology as the main study participants because they have the best information concerning the study (Terrell, 2016:75; Creswell, 2014). Hence, observation, interviews and participatory design methods that included brainstorming and co-designing (Manzini, 2015; Bratteteig, 2014:13; Siedel & Fixson, 2011:3-5) were the main means of data collection from the study participants. The data gathered comprised the design students' ideas about climate change and environmental sustainability. This multiple methods data collection strategy was meant to strengthen the findings of the gamified learning activities that were also informed by the graphic design students' understanding of the two concepts of climate change and environmental sustainability.

Gamification workshops were designed to serve as a pedagogical tool for examining the participating students' perceptions on environmental sustainability and climate change matters within the non-gaming context of design education. The gamified learning experiences were explored through design-led activities with the participating graphic design students. Design methods were selected to provide rich and valuable visual data from the perspective of the study participants within the instructional context of graphic design. The aim was to get the students in the selected HEI to appreciate the two abstract concepts of climate change and environmental sustainability in this non-gaming context of design education. Hence, the information that was obtained from the participating design educators served to gauge their willingness to promote environmental and sustainable design practices through game-based learning.

The gamified workshop activities aligned to the research objective that sought to develop a gamification framework that could guide the teaching of environmental and sustainable design practices within the selected context. Using gamification as a teaching tool inside the non-gaming framework of design education made it possible to test the students' perceptions on issues relating to environmental sustainability and climate change.

#### **6.4.3. Practical contributions**

The contextualised game-based learning framework for education (see Figure 4.34 in Chapter 4) that evolved through the study has been proposed to guide graphic design educators who want to introduce environmental sustainability practices into their graphic design education curricula. The framework can serve as an analytical tool to inform the selection of gaming elements to improve the overall human experience of game-based learning.

This study was conducted through design research methodologies. Design-led workshops were organised as a component of the gamified learning activities where the study participants worked on design projects using graphic design tools such as text, images and illustrations (Motley, 2017; Dritz, 2014; Liedtka, 2015; Manzini, 2007) to advocate environmental sustainability and climate change matters as part of the game-based learning experiences. The students developed sustainable advertising campaigns that contributed to knowledge about climate change and environmental sustainability and the theory and application of gamification.

Tangible outcomes of these design workshops were designed artefacts on climate change and environmental sustainability, that included media advertising campaigns and promotional flyers, posters, placards, branded T-shirts, videos, jingles for radio and television commercials, using graphic design tools such as text, photos, videos and audio recordings. These projects focused on identifying problems in Ghana which could be solved through design to effect change. The learning activities were characterised by open display and active presentation on each group's project. The process enabled members of other groups to ask questions of the presenters, critique the projects, and assess the extent to which the core values of environmental sustainability and sustainable design practices had been incorporated in them. The class graded each project but participated actively in judging the best three projects for awards. They left the final decision to assess the artefacts to the course educator. The study period ended before the students completed the tasks. The students submitted their projects and presentation reports to their course educator for grading towards the end-of-semester assessment.

This approach to climate change education via the graphic design curriculum was adopted as a practical sustainability strategy. The premise was that "the emphasis of climate change education is learning, not teaching" (Filho *et al.*, 2014:3). Moreover, "education is one of the most powerful tools that can engage young people in the debate, prepare them for working with the green economy and give them the definitive science and facts about the biggest issue facing young people" (Dyster, 2013:3). This study is therefore my strategy for contributing to global climate change and environmental sustainability education and my contribution to the global conversation and literature on climate change, environmental sustainability and possible pathways to a sustainable future (Ojala, 2015:134) from the graphic design perspective. The basis is that "designers and design researchers have a unique contribution to make regarding issues of climate change due to their multi-modal ways of thinking, doing and intuiting change and offering solutions" (Sevaldson, 2010 in Chisin & Mainsah, 2014). In this regard, this study has shown that graphic design students have tools that they can deploy to communicate information to effectively promote environmental sustainability from the Ghanaian perspective.

This study highlights gamification as a powerful and flexible persuasive tool that can be readily applied to any problem that can be solved through influencing human motivation to inspire behavioural change benefits (Al-Azawi *et al.*, 2016:132; Hamari *et al.*, 2014:3026). The implication is that game-based learning can be adopted as a flexible pedagogical strategy to innovate graphic design education as well as to advocate climate change and sustainability issues in Ghana's

educational system. The outcomes of this study reinforce my belief that graphic design tools such as text, photos, videos and audio recordings that incorporate the core values of environmental and sustainable design practices can be used to contribute to what the world knows about climate change and environmental sustainability through the application of gamification. Hence, design educators can incorporate sustainable design practice through gamification into the design curricula in particular, to push the UN Sustainable Development Goals agenda (see Opoku-Asare, Chisin & M'Rithaa, 2019; Debrah, Opoku-Asare & M'Rithaa, 2019).

This is a novel study that draws attention to the need to focus also on graphic design and game-based learning as a feasible approach to implementing climate change education in the context of higher education in Ghana, and by extension, throughout the education system. The research findings attest to this study having achieved the objective of occasioning the graphic design students to understand the need to think about the environment and infuse the knowledge into the design of their products and services.

## **6.5. Study summary**

This study explored gamification or game-based learning as a pedagogical tool to promote environmental sustainability and climate change thinking through game-based learning strategies within the context of graphic design education in an HEI of technology in Ghana, the premier institution that trains designers for the operational to management levels of the local graphic design industry in Ghana. The participating students were third-year undergraduates who were majoring in three graphic design course options: Advertising and Media Management, Filmmaking and Animation, and Multimedia and Photography.

This study responded to the call to “expose the current and next generations of citizens to the significant impact and consequences of climate change on the earth’s natural environment and humanity” (Hu & Chen, 2016:3; Mason-Jones & Towill, 2016; Mishra *et al.*, 2015). The fundamental consideration is that sustaining the natural environment has direct positive implications for life on Earth (IPCC, 2018; Riecken *et al.*, 2017; Vardoulakis *et al.*, 2015). The study answered this call by educating graphic design students in the selected university of technology in Ghana about global warming-induced climate change as a way of encouraging these young people’s preparedness for the adverse consequences of climate change in order to

help sustain the environment and humanity (Gustafsson & Ijla, 2016; Stevenson *et al.*, 2017; Boon, 2016).

The study occurred in two phases with an initial group of 75 students (Phase 1) in the three graphic design course options: Advertising and Media Management, Filmmaking and Animation, Multimedia and Photography. The replication phase involved 90 students (Phase 2). The study adopted the design-thinking approach by co-designing using visual methods (Madden & Andrew, 2016; Debrah *et al.*, 2015; Manzini, 2015; Sanders & Stappers, 2014; Johansson-Sköldberg *et al.*, 2013; Kimbell, 2012) to engage these 165 undergraduate graphic design students in two design-led workshops in the selected university of technology in Ghana. The gamified learning experiences were integrated into the normal design lessons and the students' ideas and learning experiences informed the outcome of the research. This approach to climate change education was considered essential to encourage the young designers to adopt socially-responsible behaviours in designing sustainable products, services and systems that focus on environmental protection in Ghana.

The responses that the 75 Phase 1 students provided for the survey via questionnaire items on climate change and environmental sustainability that was administered after the initial conversational interactions with them, showed they had little knowledge about the two concepts. Less than 25 per cent of this group of students knew much about climate change and environmental sustainability, with many of them expressing their ideas as “basic”, “a lot”, “not very much” or “I don't know anything about climate change and environmental sustainability”. Contrary to this, the responses given by the Phase 2 group of 90 students after they had participated in the gamified learning experiences, expressed enhanced learning in relation to literature on the two concepts. This suggests the advantage that the 90 Phase 2 participants enjoyed from exposure to climate change information through conversation, independent and group study, discussions of climate change images, videos, *Kahoot* application, the “climate change edition” of the *30 Seconds* board game, and other online resources that were used for the gamified learning activities.

The survey responses revealed that the majority (51.5%) of the 165 students had obtained information about climate change and environmental sustainability from the combination of *television/radio/newspaper/internet/friends and family*. The minority (24 out of 75 in Phase 1; 21 out of 90 in Phase 2) of the 165 students reported learning about the two concepts from



educational resources, suggesting that specialist publications/academic journals/environmental groups were not regular educational resources and reference materials that the students consulted.

It was clear that the gamified activities both raised awareness and clarified the knowledge of the study participants to perceive climate change as a “Very important” issue that must be understood as a critical factor in the survival of humanity on planet Earth (Reckien *et al.*, 2017). To this end, the number of students who rated climate change *very important* increased significantly from 10 in Phase 1 to 47 in Phase 2. Unlike 31 of the 75 Phase 1 participants who rated climate change as *not very important*, all one hundred percent of the 90 Phase 2 participants considered the phenomenon “important”. The improved ratings showed significant and enhanced appreciation of the information that was shared as part of the gamified learning activities.

## **6.6. Conclusions**

The data analysis and discussion attest to the relevance of this study as it highlights the critical need for graphic design students in this HEI of technology to be made aware of climate change and environmental sustainability so they would understand the need to think about the environment and infuse sustainability into their design of products and services. As Mochizuki and Bryan (2015) and Stevenson *et al.* (2017) have concluded, more people would be informed about climate change and environmental sustainability if these design students shared what they had learned with their families and communities.

The fact remains that climate change is an important issue that individuals are being encouraged and inspired to work towards abating its unwanted impacts in order to sustain the natural environment and save humanity (Stevenson *et al.*, 2017; Whitmee *et al.*, 2015; Wolf & Moser, 2011). In the view of Sevaldson (2010) in Chisin and Mainsah (2014), “designers and design researchers have a unique contribution to make regarding issues of climate change due to their multi-modal ways of thinking, doing and intuiting change and offering solutions”. In this regard, the study projected that the graphic design students have tools that they can deploy to communicate the complex and often abstract concept of climate change in appropriate messages that people in Ghana can understand and act on it (Malhotra *et al.*, 2013:1265; Moser & Dilling, 2004:34) as well as raise awareness about environmental sustainability and possibly get climate change education factored into and mainstreamed throughout the school curriculum in Ghana,

towards inducing adoption of positive attitudes and socially responsible behaviours towards the two phenomena (Kagawa and Selby, 2010; Anderson, 2012).

Both phases of the study pointed out that lack of education on the causes of climate change is what pushes people to resort to activities that contribute to the fast-changing climatic conditions. There is also a lack of advocacy campaigns to educate and create awareness to make people aware of the situation, so they take responsibility for their behaviour.

The interactions on climate change and environmental sustainability and the time the study participants spent watching and discussing relevant videos and images gathered from various parts of the world obviously gave the participants a better understanding of the phenomenon and made the reality and relevance of climate change advocacy campaigns clear to them. The survey in both phases of the study pointed out that lack of education on the causes of climate change is what pushes people to resort to activities that contribute to the fast-changing climatic conditions. There is also a lack of advocacy campaigns to educate and create awareness to make people aware of the situation so they can take responsibility for their behaviour.

The study highlights the fact of climate change not being taught effectively from primary school through senior high school to the university level. It is, however, taught to students who study environmental science, geography, biology and social studies. Moreover, climate change is not taught as an environmental issue to be addressed or educate people about. Having 21 “No” and 17 “Not sure” responses imply uncertainty about the teaching of climate change in all the schools in Ghana. Boakye’s (2015) findings about climate change in schools resonates here.

The fact that climate change is an important issue is seen in the study. This raises awareness of the threat of climate change to human survival on Earth, particularly in Ghana, on account of the country’s dependence on rain-fed agriculture for food and economic development (Kagaya *et al.*, 2020; IGGS, 2015; Asante & Amuakwa, 2014; Arndt et al, 2015).

This is a novel study that draws attention to the need to turn attention also to graphic design and game-based learning as a feasible approach to implementing climate change education in the context of higher education in Ghana, and by extension, throughout the education system. Hence, this study is my contribution to the global conversation on climate change and environmental

sustainability from the Ghanaian perspective. It also raises awareness on the threat of climate change to human survival on Earth.

This study highlights gamification as a “powerful and flexible persuasive tool that can be readily applied to any problem that can be solved through influencing human motivation to inspire behavioural change benefits” (Dicheva *et al.*, 2015; Lucassen & Jansen, 2014; Hamari *et al.*, 2014:3026). Game mechanics are also increasingly being used by companies to provide “rewards for making good, green choices” (Conaway & Garay, 2014; Joel, 2013:9; GreenBiz Group report, 2012). The implication is that game-based learning can be adopted as a flexible pedagogical strategy to innovate graphic design education as well as advocate climate change and environmental sustainability issues in Ghana’s educational system.

This study explored gamification as a pedagogical tool to advocate environmental sustainability and as an alternative strategy to address climate change problems within the context of design education in Ghana. Thus, the findings presented in Section 5.2 (see Chapter 5) informed the gamification strategy that was adopted to facilitate the graphic design students’ understanding of the two related abstract concepts of climate change and environmental sustainability.

Literature reviewed for this study indicates that gaming is being implemented in many educational programmes, which are non-gaming contexts. Moreover, educational gamification is deemed a valued approach for young students to learn about and take care of the environment (Manzano-León *et al.*, 2021:3; Rajanen & Rajanen, 2019:254; Ro *et al.*, 2017:21; Mishra *et al.*, 2015:122). Yet, gamification and its potential for educational purposes has not been fully explored in Ghana, and it seemed unclear at the start of this study how this methodology could be adapted as a pedagogical tool to promote environmental sustainability as part of graphic design education as a way of promoting green gamification.

The data analysis and discussion, however, attest to this study having achieved this objective by making the design students aware of the two phenomena so they would understand the need to think about the environment and infuse sustainability into their design of products and services. Gaming enabled me to infuse graphic design lessons in a non-gaming context (university classroom) to “help educators find the balance between achieving their objectives and catering to evolving student needs” (Pho & Dinscore, 2015:1–2). The basis is that game-based learning provides “flexible, student-centred or constructivist environments that encourage cooperative

problem-based learning and adoption of positive values typically associated with games” (Dicheva et al., 2015; Boyle et al., 2011). Moreover, game-based learning “creates opportunity and structure for learners to engage actively in the teaching-learning process, share information and ideas with their peers, collaborate to perform tasks and solve problems in a pleasurable way, which assists them to understand what they learn, retain and recall information from games better than with other teaching approaches” (Adipat et al, 2021:543-544; Israel, 2017:3-4).

## 6.7. Recommendations

This study has adequately demonstrated the power and flexibility of gamification as a “persuasive tool” (Dichev & Dicheva, 2017; Al-Azawi *et al.*, 2016; Hamari *et al.*, 2014; Werbach, 2014; Deterding et al, 2011) that can be used in educational programmes to communicate the impact of climate change on the environment to young people (Marzano-Léon *et al.*, 2021; Rajanen & Rajanen, 2019; Froelich, 2015). Gamification is one experiential learning approach that facilitates interaction, collaboration, peer learning, active learning and simultaneously keeps students motivated in learning situations (Byrne, Ito & Furuyabu, 2022; Subhash & Cudney, 2018; Sailer et al, 2017; Martí-Parreño *et al.*, 2016; Caponetto, Earp & Ott, 2015). Games motivate learner engagement and are also well-liked by young people (Škuta & Kostolányová, 2016:427; Kalinauskus, 2014; Johnson *et al.*, 2014; Nicholson, 2012). Gamification can therefore be adopted by design educators in particular, to incorporate sustainable design practice through gamification into the design curriculum to push the UN Sustainable Development Goals agenda (see Opoku-Asare, Chisin & M'Rithaa, 2019; Debrah, Opoku-Asare & M'Rithaa, 2019), on account of the fun that underlines learning with gaming (Kim, 2015; Bicen & Kocakoyun, 2018).

The following proposed recommendations guide the uptake of the outcomes of this study:

1. Gamification is a viable alternative strategy to advocate environmental sustainability within the context of the graphic design curriculum for addressing climate change problems and their communication. This approach to climate change education can encourage young graphic designers to adopt socially responsible behaviours towards reducing the stark risks of climate change in Ghana. Game-based learning strategies such as *Kahoot* and *30 Seconds* can be applied to extend climate change and environmental sustainability education to students in secondary schools, colleges and universities.

2. The Octalysis model of gamification is suitable for this approach to climate change education since the framework focuses on the human aspect of gamification. The three core drives of White Hat gamification, which are Epic meaning and calling; Development and accomplishment; Empowerment of creativity and feedback are the emotional drives of the Octalysis framework. Because they focus on the positive side of gamification and provide techniques that make players feel good and powerful, they are ideal for connecting the demands and needs relating to climate change and design education to enhance and facilitate behavioural change towards environmental sustainability.
3. Climate change is a complex social and scientific issue that can be dealt with through education so people can effectively build the needed capacity to address the communication problems. Gamification and its mechanics of badges, levels and leaderboards are necessary tools that can conveniently be applied with visual design methods such as video, illustrations, photographs, drawings and storytelling to break the complex climate change information into simple ideas that can be easily understood.
4. Game-based learning conducted through design-based research is a human-centred approach to promote more sustainable futures. Participatory design workshops and experiential learning activities that involve the use of graphic design tools such as text, audios and videos can be adopted to introduce sustainable practices to graphic design students.
5. The contextualised game-based learning framework (see Figure 4.34, Chapter 4) for education that evolved through the study can serve as a precedent for other graphic design educators when introducing environmental sustainability practices as part of graphic design education. It can also be adapted by HEI educators in other course areas. The framework can serve as an analytical tool to inform the selection of gaming elements that can improve the overall human experience.

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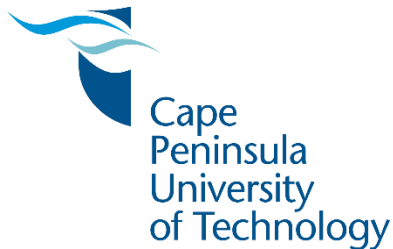
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## 8 APPENDICES

### APPENDIX A: PERMISSION LETTER AND CONSENT FORM



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### QUESTIONNAIRE FOR COMMUNICATION DESIGN STUDENTS

The investigation is part of my postgraduate studies leading to a master's degree in Design. The study revolves around gamification as a pedagogical tool to promote environmental sustainability. In this questionnaire I am seeking to explore possibilities of integrating environmental sustainability as part of the communication design program and using gamification as an instructional tool.

Your assistance and collaboration to achieve this purpose is much appreciated. The outcomes obtained from this study will assist design educators to integrate sustainable design principles into their teaching practices using gamification to advocate environmental sustainability in the design program.

An emerging adjustable gamification framework will be proposed which can be further modified for use in similar contexts. Therefore, the responses provided in this questionnaire must be all accurate. The responses obtained will be shared for academic purposes only and not for any other use. All information will be confidential and the personal information including names, faculties and instructors will be kept with utmost privacy.

Please kindly respond to all questions with the relevant answers.

Thank you for your willingness to complete this questionnaire.

Please be informed that your participation in this research is on a voluntary basis and you may choose to withdraw at any point in time.

For further information and additional comments, please contact or email me at:

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<b>CONSENT FORM</b>		
<b>Topic: Gamification as a pedagogical tool to promote environmental sustainability in a university of technology</b>		
This consent form is designed to check that you understand the purposes of the study, that you are aware of your rights as a participant and to confirm that you are willing to take part.		
<b>NO</b>	<b>YES</b>	
1. I have read the briefing about the research.		
2. The information about the research is sufficient for me to make a decision to participate.		
3. I understand that I am free to refuse participation.		
4. I understand that I can choose to participate or withdraw from the study without any reason.		
5. I am aware that I can request further information from the researcher/ research team.		
6. I understand that all data from the study will be treated as confidential and with anonymity.		
7. I agree to participate.		
Signature:	Date:	

Name please:		
I confirm that quotations from the interviews and surveys can be used in the final research report and other publications. I understand that these will be used anonymously and that no individual respondent will be identified in such a report. Except in cases where stated by the respondent to be reported as such.		
I agree that images and artefacts can be used in the final research report.	YES	NO
Signature:	Date:	
Name please:		

## APPENDIX B: GAMIFIED LEARNING - EXAMPLES OF CASE STUDIES

**Case One:** This case study was conducted at the Delft University of Technology in the Netherlands, which involved game-based learning activities. Participants in this gamified learning experience were both undergraduate and master's students enrolled in cloud computing courses. In this study, game-design mechanics were used to increase students' engagement with the course and learning throughout the term. Feedback from students and assessment reports obtained from instructors during the game-based learning experience was positive. Instructors were pleased with the progress made by learners and their interest in the course over the period. In this context of gamifying learning experiences, it emerged that "the role of a teacher and the role of game rules are roughly equivalent" (Oxford Analytica Ltd, 2016:20). A teacher wants to exert influence on students to encourage certain behaviours; to reward the positive and discourage the negative (Al-Azzawi *et al.*, 2016:132). Steven Lumpkin, a senior designer for *Roller Coaster Tycoon World* noted that in games, rules are designed to guide players through a level or stage in an intuitive manner (Oxford Analytica Ltd, 2016:7).

**Case Two – Pilot study:** As part of this research, a pilot study was conducted in Tafari, Kenya, as part of a *C-San Futures* international design research project. I was part of a team of design students participating from different countries in an artist residency in a design futures course dubbed "ProtoHype" in the Tafari community. The *ProtoHype* project engaged a team of design students "to explore, describe and deliver contextually relevant design solutions through what we call "design foresight" in situated learning (see Raymond, Opoku-Asare, Chisin & Morrison, 2016:138). We were assigned a design challenge in our various teams which was aimed at prototyping sustainable energy solutions for community members in Tafari. In my team we proposed an environmentally sustainable solar energy system for the Tafari community. We realised that the locals in this community will need education on how to use the energy system when it is finally implemented.

In order to close this gap, we proposed visual gaming tools for educating community members on operating the solar energy system. These game-based tools were designed using gaming mechanics to propagate the concept of solar energy and environmental sustainability. The gaming tools were in the form of *flash playing cards, posters, storytelling and narratives* (see Figure 4.1).

The proposed gaming tools served as a pilot for using gamification in a nongaming context and became a starting point for this study (see Raymond, Opoku-Asare, & Debrah, 2016). Projections

are that the proposed game-based tools could be used for educational purposes in the community to meet the following goals:

- a. Educate the surrounding communities and potential clients on the general knowledge and benefits of solar power.
- b. Train the staff of Tafaria, tutors, clients and entrepreneurs who will purchase and retail the products in the community.



**Figure 8.1: Sample of proposed gaming tools for use in a non-gaming context (Artist residency team, 2017)**

## APPENDIX C: THE SURVEY QUESTIONNAIRE

Please respond to the following questions by simply indicating answer with (\*) or (#) in the relevant spaces provided. You can also write your responses in the spaces provided.

### SECTION A: CONTEXT

1. Which course are you studying at moment in your university?

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2. What is your major option in communication design?

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3. Which year are you now in the design program?

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4. How many years have you been in the field of design?

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### SECTION B: CLIMATE CHANGE AND ENVIRONMENTAL SUSTAINABILITY

5. Do you know about climate change and environmental sustainability?

Yes  No

6. What aspect of environmental sustainability are you familiar with?

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**SECTION C: MEDIUM OF CLIMATE CHANGE INFORMATION**

7. What are some of the sources where you have obtained information about climate change/ environmental sustainability? Tick as many as you feel apply.

- Television Radio Newspaper Internet
- Specialist publications/academic journals Environmental groups (e.g., Wildlife Ghana)
- School/ college/ university Government agencies/ information Public libraries
- Friends/family
- Other: \_\_\_\_\_

**SECTION D: INTEREST IN CLIMATE CHANGE**

8. How important is the issue of climate change to you?

- Very important
- Quite important
- Not very important
- Not at all important

9. As a designer what do you think might be some of the causes of climate change?

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10. What impacts, if any, do you think climate change may have on the environment?

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11. To the best of your knowledge, are climate change awareness campaigns carried out?

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12. Do you think anything can be done to tackle climate change?

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13. To the best of your knowledge, do the schools teach students about climate change?

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14. What does climate change mean to you? Tick all that apply.

- A. Change in temperature
- B. Change in the environment
- C. Change in weather conditions
- D. Change in climate due to human pollution
- E. Change in climate due to global warming
- F. I don't know
- G. Other: \_\_\_\_\_

15. What do you think are the effects of climate change? Tick all that apply.

- A. Sea level rise
- B. Drought
- C. Flooding
- D. Global warming
- E. Rising temperatures
- F. Increasing intensity and frequency of extreme weather events
- G. Other: \_\_\_\_\_

16. Which of the above do you think will affect Ghana as a consequence of climate change?

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17. Who do you think will be mostly affected due to the effects of climate change?

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18. To the best of your knowledge what changes would you be willing to make to increase your preparedness to minimise the effects of climate change as a designer?

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19. To the best of your knowledge are climate change awareness campaigns carried out at your university?

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20. Were you taught about climate change in senior high school?

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21. What role do you think designers can play in contributing towards climate change and environmental sustainability?

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22. Are you aware of anything you can do to curb this issue as a designer?

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23. What would you suggest designers do to help solve this problem of climate change in order to sustain the environment?

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**THANK YOU FOR YOUR TIME😊**

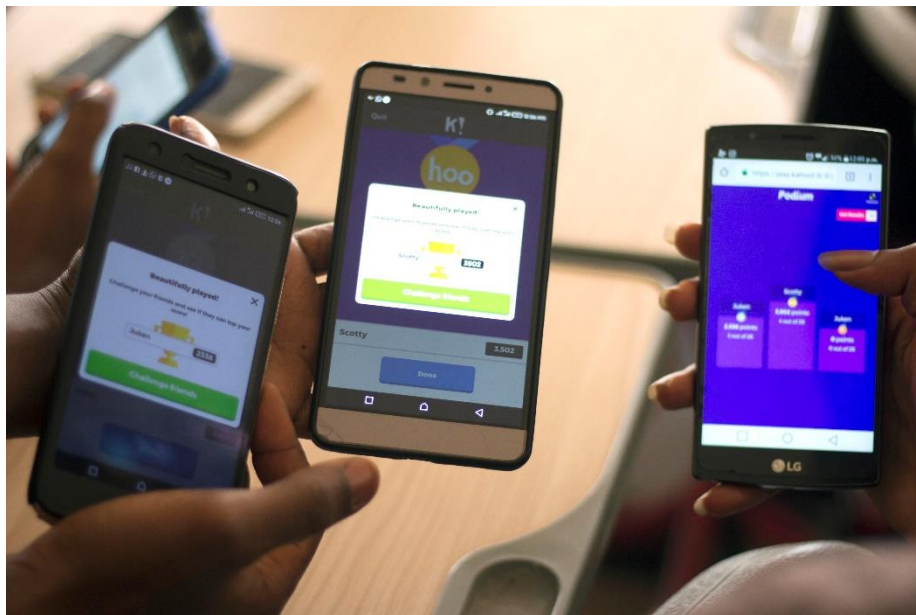
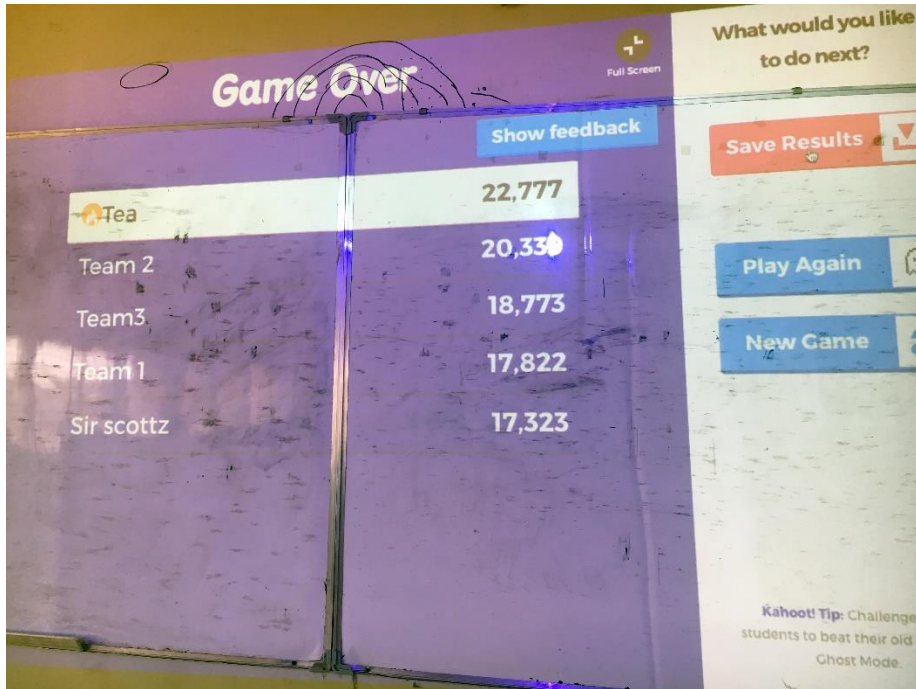
Kindly return all completed questionnaire to the researcher (assistant) who administered these questionnaires to you.

Further information please contact the researcher:

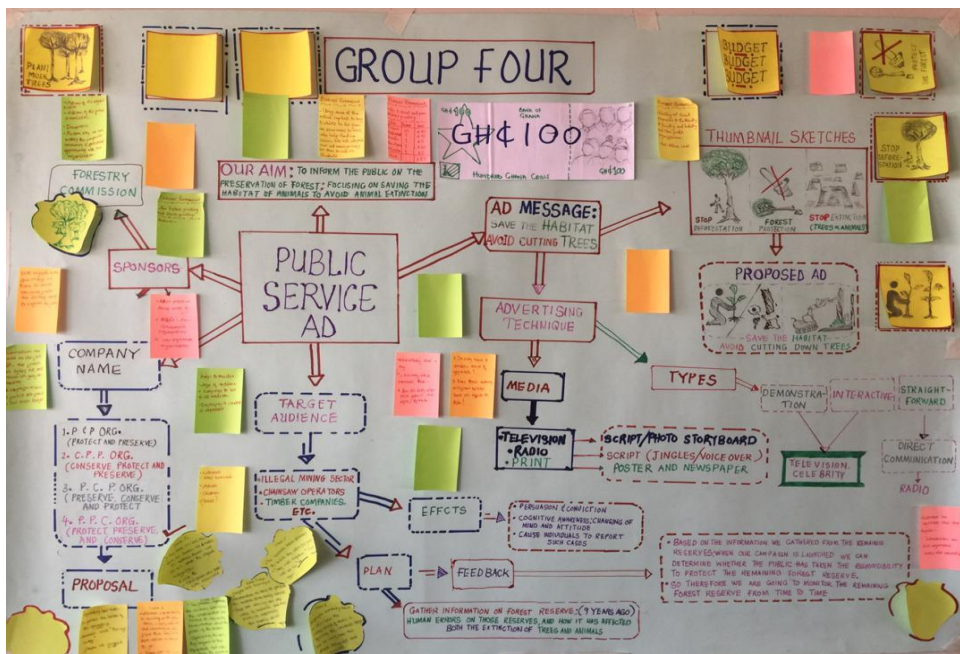
Cell: +27 (0) 62-67-66441

E-mail: [nanasarek@gmail.com](mailto:nanasarek@gmail.com)

## APPENDIX D: GAMES THE STUDENTS PLAY



## APPENDIX E: SELECTED PROJECTS THE STUDENTS INITIATED



**APPENDIX F: THE AWARDS CEREMONY**



## **APPENDIX G: RESEARCH OUTCOMES**

Raymond, C.E., Opoku-Asare, K. & Debrah, R.D. 2016. Tafaria sustainable energy system: LeNSes Conference Exhibition, Cape Town, South Africa. 24th October, 2016. Available at: <https://www.scribd.com/document/326733133/LenSes-design-competition-catalogue>.

Raymond, C.E., Opoku-Asare, K., Chisin, A.V. & Morrison, A. 2016. Futures thinking through transposition: Cumulus Hong Kong proceedings. Hong Kong. 21<sup>st</sup> – 24<sup>th</sup> November, 2016.

Opoku-Asare, K., Chisin, V.A. & Mugendi, K.M. 2019. Game-based learning: increasing learner participation through gamification mechanics. DEFSA 2019 Conference Exhibition. 24th October, 2016.

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Debrah, R.D., Opoku-Asare, K. & M'Rithaa, M.K. 2019. Design + change in Afrika: an integration of sustainable development goals (SDGs) in a design curriculum. WDO 2019 Research and Education Forum Proceedings / Humanizing Design. Hyderabad, India. 10<sup>th</sup> October, 2019.



