MM-DB

The influence of gaming on digital intelligence in South African organisations.

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A research proposal submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business

Johannesburg, 2023

ABSTRACT

The digital age is argued to require digital skills that are fit for purpose. Digital intelligence (DQ) has been put forward as a form of intelligence required to facilitate problem-solving in the digital environment and yet its development is not fully understood. On the other hand, previous research has shown the cognitive benefits of video gaming or gaming. This quantitative study used Nonprobability convenience sampling with snowballing to examine the influence of gaming on digital intelligence in South African organisations. The study found no statistically significant relationship between gaming and DQ in South African organisations. The study also found that demographic factors of individuals did not moderate the relationship between gaming and DQ and that exogenous factors may have a stronger influence on the relationship. Limitations of the study were the unequal representation of gamers and non-gamers, the administration of the survey on a single population grouping and the possibility of self-bias by participants.

KEYWORDS

Keywords: Digital intelligence, DQ, video gaming, 4IR, cognitive development.

DECLARATION

I, ___Lawrence Kanotsauka_____, declare that this research report is my own work except as indicated in the references and acknowledgments. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Name: Lawrence Kanotsauka Signature: 

Signed at ……Fourways……

On the ……3rd…….. day of ……April…… 2023

ACKNOWLEDGEMENTS

I would like to start by thanking my family and dedicating this research project to them. To my Wife, Mahlwayi you have always supported me throughout my academic journey. Your unwavering, encouragement, and sacrifices have been the foundation of my success. To my children, Daphney, Laura, and Jed thank you! Your support and understanding have been invaluable to me. To my parents for believing in me and my siblings for their understanding when I could not attend family events.

My sincere gratitude goes to all my lecturers, who have shared their knowledge, wisdom, and expertise with me. Professor Gregory Lee my supervisor, you have taught me the true meaning of patience and humility. To Senteni Nsibande our Program Manager at Wits Business School for your support to the entire cohort, without your hard work it would have been difficult to complete this program.

A special acknowledgment to my full-time cohort of 2022. Special mention to Upenyu Toma, Olebogeng Mataboge, Thabani Msibi, Matuma Mosidi, Ntokozo Mthimkhulu, for your support and encouragement during the lows and the celebrations during the highs. My final thank you goes to all who have been part of my learning journey and what a journey it has been, thank you for your guidance which has been instrumental in shaping my career and aspirations.

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DQ – Digital intelligence quotient

IDG - Internet Gaming Disorder

IQ – General Intelligence

DT – Digital Transformation

4IR – Fourth Industrial Revolution

IT – Information Technology

Identity – Digital Identity

Use – Digital Use

Communication – Digital Communication

Emotional – Digital Emotional Intelligence

Safety – Digital Safety

Security – Digital Security

Literacy – Digital Literacy

Rights – Digital Rights

CHAPTER 1. INTRODUCTION

1.1 Statement of purpose

This quantitative study examined the influence of gaming on digital intelligence in South African organisations.

1.2 Background of the study

Modern digital economic development is a challenging topic. It presents both problems and opportunities and requires the development of skills and competencies for success and survival, (Wiśniewska-Paź, 2018). The Fourth industrial revolution (4IR) challenges South African companies to adapt to global and local market disruptions, (Kozarkiewicz, 2020). Digital transformation, which leverages new digital technologies, new business models, and digital competencies, creates significant managerial challenges, (Blanka, Krumay, & Rueckel, 2022; Fernandez-Vidal, Antonio Perotti, Gonzalez, & Gasco, 2022)

Electronic or video gaming has been linked to brain and cognitive benefits, motivating researchers to investigate how to combine gaming's cognitive benefits with individual competency development training programs, (Kühn, Gallinat, & Mascherek, 2019; Sublette & Mullan, 2012). Gaming is popular and widespread, and because scientists are discovering links to cognitive development, it may be feasible for organisations to leverage its advantages in training their employees.

Digital intelligence is a construct of essential digital skill sets required to meet the needs of the 21st century, (DQ Institute, 2021). Because gaming is a prevalent social activity, if it can be understood how it influences digital competencies such as digital interaction behaviours and cyber security understanding, then it may be important for businesses to understand these connections and potentially design training interventions based on knowledge derived from gaming experience.

In previous revolutions, technical improvements spurred competency growth. Digital competency is vital for digital innovation in the 4IR, where digital transformation is aiding the transition from the 3IR, (Blanka et al., 2022). Today new technologies are altering how competencies are learned, (Phunaploy, Nilsook, and Nookhong, 2021). Using a different lens to identify interventions that could assist South African organisations, may help to increase their participation in the digital economy.

However, it remains unclear if gaming is indicative of digital intelligence. By evaluating digital intelligence through the lens of video gaming, this research intends to expand the understanding of digital competence development techniques. If a link can be found it may have specific and specialised applications in training program designs. Such as the development of games that facilitate cognitive development as an exercise in a work setting. This may assist South African businesses to offset the effects of the digital revolution and decrease the risk of falling behind the competition, (Magwentshu, Rajagopaul, Chui, & Singh, 2020).

This study seeks to start the debate amongst the South African business community and academia on digital intelligence and gaming experience. Further research in this area may influence changes in deep-rooted and entrenched human resources management practices of legacy businesses, that must evolve, adapt, and coexist with practices better suited for digital environments (Fernandez-Vidal et al., 2022).

1.3 Research question

Does gaming influence digital intelligence (DQ) in South African workers?

Sub Questions:

i. Is there a relationship between gaming and DQ amongst South African workers?

ii. Do demographic factors moderate any relationships between gaming and DQ?

1.4 Rationale

Adams (2004), claims that a new intelligence has arisen, termed digital intelligence. This form of intelligence, which facilitates problem-solving in the digital environment, has been formalized and promoted by numerous writers, (Adams, 2004; Cismaru, Gazzola, Ciochina, & Leovaridis, 2018; Grasser, Schlaipfer, Priedl, & Sorantin, 2018; Marnewick & Marnewick, 2021a; Moreno, Court, Wright, & Charnley, 2019).

Over the decades, essential skills have evolved from physical to digital. Today, physical skills are declining, but cognitive, soft, and digital skills are expanding and as the 4IR unfolds, the necessity for digital skills is predicted to continue to increase, (Marnewick & Marnewick, 2021b).

Gaming provides a new way of learning and cognitive development, providing new ways to understand cognitive development (Yan, Li, Lou, Li, Yao, Gong, Ma, & Yan, 2021). Cognitive ability is argued to predict job performance in different job types (Hunter, 1986; Schmidt, 2002).

In summary, digital intelligence is argued to provide the competencies required in the digital age, whilst gaming is linked to cognitive benefits. Therefore, a deeper analysis of their relationship is needed to determine their potential contribution to South African enterprises' digital transformation journeys through the development of their people. The inability to find new paradigms that enable learning agility in the digital age may result in an inability to navigate it by those who participate in it at its various levels, (Fernandez-Vidal et al., 2022; Sobczak, 2018).

Practical significance – If links could be found between gaming and DQ, then this may have added to the body of knowledge on specialised training program design. This study's findings could be used as an indicative factor for recruitment

and selection by managers and Human Resource practitioners. This study will start the conversation about gaming's influence on digital intelligence development.

Theoretical significance – This study added to the growing body of knowledge aimed at understanding cognitive differences between individuals. It also add literature that expand research in digital transformation beyond its existing domains (Kraus, Durst, Ferreira, Veiga, Kailer, & Weinmann, 2022).

1.5 Delimitations of the study

This study has the following delimitations:

i. It is limited to workers in South Africa, both employed and unemployed who have access to the internet.
ii. It does not include physical video games such as Nintendo sports.
iii. The study is limited to the participants' gaming experience, frequency, and duration and does not include the gamer's preferences, likes, and dislikes for the games.
iv. It does not include the study of the negative impact of gaming.

1.6 Definition of terms

Avatar - avatars are digital representations of the user in a digital environment (Nowak & Fox, (020).

Cognition - The gathering, storage, interpretation, comprehension, and application of external or internal information (Lachman, Lachman, & Butterfield, 2015)

Competency - This is the primary trait of an individual that is typically linked to effective work or situational performance, (Ribeiro, Amaral & Barros, 2021).

Digital Transformation - a firm's business strategy to transform its operation through the use of cutting-edge digital technology to increase quality and efficiency, (Zhai, Yang, & Chan, 2022).

Digital Intelligence – This is the "ability to acquire and apply new knowledge and skills related to digital technologies", (Boughzala, Garmaki, & Chourabi, 2020 p 320).

Digital Intelligence Quotient (DQ) - "a comprehensive set of technical, cognitive, meta-cognitive, and socio-emotional competencies that are grounded universal moral values and that enable individuals to face the challenges and harness the opportunities of digital life" (DQ Institute, 2021).

Gaming – The time spent playing video games.

Video gaming/gaming – The activity of playing electronic games, (Denilson, Nouchi, & Kawashima, 2019)

Video gamers/gamers - Those who participate in gaming or play video games.

1.7 Assumptions

This study makes the following assumptions:

i. Participants in the Information Technology (IT) or technology-related fields may present higher DQ due to their increased exposure to digital systems.
ii. There are socio-economic variables that may impact the DQ of participants such as previous education.
iii. There are environmental variables that may impact the gaming experience of participants such as access data and smart devices.
iv. That all participants have had some exposure to digital technologies in one form or another.
v. There are variations in gaming experience between younger professionals in comparison to older professionals caused by increased access to technology for younger generations.

CHAPTER 2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

The next chapter is a review of literature on digital intelligence, and gaming. It begins with an introduction followed by a review of existing literature and paradigms concerning the constructs of gaming and DQ. The literature review has three key themes, beginning with intelligence and digital intelligence. A review of gaming and cognition follows. Additionally, literature concerning demographics and their relevance in the context of South Africa is explored.

This is followed by an outline of the guiding theories for this study, the Multiple Intelligence theory, and the Information Processing theory. An outline of the study's conceptual model is then presented before the conclusion of the literature review.

2.2 Definition of topic or background discussion

Today, organisations are expected to use digital technology to enhance their chances of success. South African organisations suffer a digital and IT skills shortage, while unemployment is on the rise in South Africa (Dwolatzky & Schofield, 2021; Stats SA, 2022). Organisational investments, be it in technology or skills development considers the most efficient means of getting the best Returns on Investment (ROI).

Gaming can improve cognition, according to some studies. Could gaming, provide the insights required to develop new efficiencies in the advancement of specialised training and therefore contribute to improving return on investment for organisations in the digital age? This study focuses on the themes of gaming because of evidence from previous studies linking gaming with certain cognitive benefits. It also focuses on themes concerning Digital intelligence because it has been touted by some scholars as the cognitive level required for the 21st century.

White collar workers make up the research population for the study because they are the group that tends to be central to digital transformation journeys in organisation.

2.3 Is there a relationship between gaming and DQ amongst South African workers?

This section of the literature review focuses on the themes of, intelligence and digital intelligence, gaming, and gaming experience. The themes outlined, enable the exploration of literature that facilitates the formulation of survey questions in sections A and B of the survey.

2.3.1 *A Case for Digital Intelligence*

a. *Definition of Intelligence*

Numerous studies in disciplines such as psychology, neurology, and cognitive sciences have examined various facets of cognitive capacity in an effort to comprehend the phenomena of general intelligence (IQ), also known as the '*g*' factor (Colom, Karama, Jung, & Haier, 2022; Dellermann, Ebel, Söllner, & Leimeister, 2019; Demetriou, Mougi, Spanoudis, & Makris, 2022).

As a result, a multitude of definitions exist. Colom et al. (2022), characterizes intelligence as the broad mental capacity for learning, reasoning, and solving problems. Wiśniewska-Paź (2018 p 170), describes intelligence as the capacity to "perceive, understand, learn, analyze and adapt" to environmental changes using one's competencies. Dellermann et al. (2019), summarizes the definition of intelligence as being competencies that humans have that are exhibited at an individual level. Freeman, (1925) concludes that intelligence refers to certain mental factors which result in or tend to result in the successful adjustment to situational problems. Gardner & Moran (2018), adopts a systems-based perspective and defines intelligence as the capacity to compute using a certain kind of data in support of a particular activity.

Despite their diversity, these definitions of intelligence demonstrate that intelligence is multidimensional and may be enhanced through learning, (Demirel, Muhammet, & Olmez, 2012). Due to this multidimensional perspective of intelligence, it could be argued that this is the reason why the concept of Multiple Intelligence has grown in popularity and application over the past few decades.

Richardson's (2022), asserts that intelligence is more than the restricted measure supplied by IQ testing provide support to the view that intelligence may exist in other forms that extend beyond IQ. General observations in everyday life provide clues to the existence of something that makes some people better at doing certain tasks than others. There is therefore an argument to be made regarding the Multiple Intelligence paradigms.

b. *Multiple Intelligences*

According to the Multiple Intelligence theory, individuals who display levels of cognitive capacity in one intelligence may not demonstrate the same cognitive abilities in another intelligence, (Gardner, 2011). This paradigm of a multifaceted perspective of human cognitive capacity or the presence of different intelligences that transcend beyond IQ is supported by several researchers who have advanced their theories regarding the constructions of intelligence, (Bernreuter & Goodman, 1941; Davis, Christodoulou, Seider, & Gardner, 2011; Gardner, 2011; Gardner & Moran, 2018; Guilford, 1967; Neisser, Boodoo, Bouchard, Boykin, Brody, Ceci, Halpern, Loehlin, Perloff, et al., 1996; Posner, 2004; Spearman, 1927; Thorndike, 1920). Consequently, it is suggested that the notion of multiple intelligences has had a global impact on educational reform, (White, 2008; Davis, Christodoulou, Seider, & Gardner, 2011).

Notably, there seems to be no clarity or agreement by the scholars on how these intelligences develop in individuals. The general suggestion, however, does appear to be that intelligence is made up of a mix of factors.

c. *Multiple Intelligence Opponents*

The Multiple Intelligence theory, popularized in the 1980s by Howard Gardner, asserts that because science is incapable of being completely inductive and absolute, there can never be a single, indisputable, and universally acknowledged number of human intelligences, (Gardner, 2011). He continues by arguing that "reason, intellect, logic, and knowledge are not synonymous" and that it is oversimplified to integrate mental faculties and human qualities into a single metric, the human IQ, (Gardner, 2011 p 7; Ricardson, 2022). The assertions by Gardner suggest that science is still making discoveries about human intelligences. They also suggest that the complete nature of human intelligence is still not fully understood. It could be argued that the general acceptance of emotional intelligence (EQ) as a type of intelligence may be in support of the assertions by Gardner and Ricardson, (Wiśniewska-Paź 2018).

Gardner's critics, who include John White and Lynn Waterhouse, doubt the scientific validity of Gardner's and others' Multiple Intelligence hypotheses, (Waterhouse, 2006; White, 2008). They argue that the classification of human intelligence should not be restricted to the few categories defined by Gardner, but should be as diverse as the categories of human ambitions, (White, 2008). More recent studies argue that the theory of Multiple intelligence is a neuromyth, which is defined as an unproven theory about neurological function that is commonly accepted (Waterhouse, 2023; Craig, Wilcox, Makarenko, & MacMaster, 2021; Rogers, and Cheung, 2020).

Although arguments by White and others introduce some level of scepticism on theory of Multiple Intelligences, there appears to be general consensus that human intelligence and cognitive capacity cannot be reduced to a single intelligence. The disagreement appears to rather center on how intelligence should be evaluated and studied and not the multi-faceted nature of human intelligence.

d. *Multiple Intelligence in Management*

Multiple intelligence theory is believed to have developmental implications, promoting executive function strategies within a business context, (Gardner & Moran, 2018). Waterhouse (2006), however, argues that Multiple Intelligence theory does not have sufficient empirical support or coherence in neuroscience (Waterhouse, 2006). Yet, Waterhouse (2006), fails to provide clear evidence supporting why some individuals are more adept than others at doing certain non-traditional IQ-based human activities. From a managerial standpoint, Waterhouse's (2006) arguments contradict Demirel et al.'s (2012) results that indicate multiple intelligence abilities support entrepreneurial thinking in small businesses.

In the context of the 4IR, necessary technical and soft skills, together with the continual development of skills and knowledge, must be combined, according to Kruger (2022). Literature and managerial practices support the Multiple Intelligence theory through their recognition of intelligences such as emotional intelligence, cultural intelligence, and moral intelligence (Heath, 2017). Therefore, it is argued that intelligence is multifaceted and cannot be reduced to a single type of intelligence nor Gardner's eight intelligences, Gardner (2011).

Considering intelligence as an isolated human phenomenon is inadequate. In the digital era, it is also important to understand the environment in which workers are expected to apply intelligent thought. Blignaut and Botha (2022), suggest that it is necessary to determine if South Africa is aware of the skills required for workforce development and job creation in the 4IR. It is in this context that this study seeks to contribute to the body of knowledge on digital competency development practices in South Africa. Therefore, the next section undertakes a literature assessment of intelligence in the digital age.

e. *What is Digital Intelligence?*

Digital intelligence has been put forward as a new intelligence that has emerged during the digital age (Adams, 2004; Cismaru et al., 2018; Grasser et al., 2018; Marnewick & Marnewick, 2021a; Martin, Ventayen, Patacsil, & Patacsil, 2021;

Moreno et al., 2019; Wiśniewska-Paź, 2018). Wiśniewska-Paź (2018), supports the concept of digital intelligence by arguing that digital intelligence is not something individuals are born with, but rather something they acquire via some form of development. Schmeichel, Vohs, and Baumeister (2003) contend that intelligent cognition is a crucial adaptive human psyche process. An argument can be made from general observation that, support for these assertions can be found in the history of human evolution where humans appear to add to their cognitive abilities in line with technological advancements.

The DQ institute (2022), and Wisniewski-Pa (2018), assert that more knowledge about the development of digital competencies is required to meet the needs of the 21st century. Digital intelligence, consisting of digital skills, digital literacy, and digital readiness, has been proposed as the next stage in competence development across all industries and demographic groups, (IEEE, 2021).

DQ is not only a measure of a person's ability to use technology, but it also incorporates emotional and social attitudes regarding digital technology and its use. This digital viewpoint on intelligence is in line with Multiple Intelligence theory, which views human potential as multifaceted. DQ gives a scale for measuring an individual's digital intelligence characteristics which can provide the basis for evidence-based interventions.

f. *The Digital Intelligence Quotient (DQ)*

DQ is defined as the total of an individual's social, emotional, and cognitive talents that allow them to adapt to the demands of life in the digital era and overcome obstacles, (DQInstitute, 2017; IEEE, 2021; Mithas & Smith, 2017; Na-Nan, Natabang, & Wongsuwan, 2020). Dr. Yuhyun Park developed the DQ framework, which is a compilation of 25 digital competence frameworks, (DQ Institute, 2022). The digital intelligence framework establishes a digital intelligence quotient (DQ) scale for measuring the digital cognitive skills of individuals. It is argued to contain the values, skills, and knowledge necessary for a person to succeed in the digital age (Phunaploy et al., 2021; Rahman, Amalia, & Aziz, 2021).

DQ provides a deeper perspective on individuals' digital competencies across eight categories (Institute, 2022). The eight components of DQ are backed by Marnewick and Marnewick (2021), who state that DQ is not just focused on technology, but also on how individuals employ socio-emotional and cognitive abilities to overcome the effects and consequences of technology. Wiśniewska-Paź (2018) adds to the claims made by Marnewick and Marnewick (2021), asserting that the logical use of this complex collection of competencies is necessary for facing and adapting to the problems of the digital world. The arguments appear to reflect the complexities that South African workers are expected to navigate in the digital world.

The DQ scale assesses the following dimensions, (institute, 2022; Marnewick & Marnewick, 2021b; Na-Nan et al., 2020):

i. **Digital identity (identity)**

The ability to construct and manage a healthy online and offline persona with honesty and the skills and talents necessary to handle challenges in the digital society.

ii. **Digital Use (use)**

The ability to analyse and utilize digital information, including mastering control to establish a work-life balance.

iii. **Digital Safety (safety)**

The capacity to manage online risks, such as cyberbullying, seduction, radicalization, despising stratification, and evaluating unlawful and banned information. The internet is the driver of the digital economy including education, business, and personal life (Kulworatit, 2021). This key digital enabler brings with it various threats which require certain skill sets to deal with these threats.

iv. **Digital Security (security)**

Capacity to maintain best practices and usage of appropriate security technologies for data protection, including self-protection as prey or threat and creating difficult-to-access passwords.

v. Digital emotional Intelligence (emotional)

The capacity to form good connections with readers in the digital society, such as caring about the feelings of others, demonstrating compassion, and being nice to assist and develop good relationships in the online society.

vi. Digital communication (communication)

The capacity to communicate and work with people utilizing digital media and technology. Communication using various forms of digital tools has become important in today's workplace.

vii. Digital Literacy (literacy)

Capabilities to utilize technology properly, analyse and comprehend digital material, evaluate its authenticity, and create, research, and communicate using the right tools and settings.

viii. Digital Rights (rights)

The capacity to respect the rights of others and to comprehend and defend personal and legal rights, including the rights to privacy, intellectual property, freedom of expression, and protection against hate speech.

DQ assesses digital intelligence aptitude it does not explain how to develop or acquire these eight dimensions. It also has some very basic questions. Despite these shortcomings, the DQ quotient continues to mature after its 2017 formalization (DQInstitute, 2017). It supports digital cognitive evaluation that provides evidence for meaningful interventions in the development of digital aptitudes.

2.3.2 *DQ and Digital Transformation*

The transformation of physical to digital (digitalization) has been argued to be transforming economies throughout the world by changing how organisations manufacture and create value (Gaglio, Kraemer-Mbula, & Lorenz, 2022). DT has been shown to affect the productivity and innovation in South African organisations especially in Medium to Small Enterprises (MSEs'), (Gaglio,

Kraemer-Mbula, & Lorenz, 2022 1). The process of transformation to digital commonly known as Digital Transformation (DT), requires capabilities that enable the extraction, analysis, and translation of data into useful insight, (Kraus et al. 2022). These assertions suggest a human interaction of interpretation and application in the digital insights.

Digital intelligence has been put forward as the appropriate response to meeting the human competence requirements of digital transformation (DQInstitute, 2017; IEEE, 2021; Mithas & Smith, 2017; Na-Nan, Natabang, & Wongsuwan, 2020). Literature appears to support the notion that creating, interpreting, extracting, analysing, and turning digital input into something of value through new business models requires certain cognitive abilities that are suited to this way of thinking. Although the World Bank reports a considerable increase in the use of the internet and mobile devices amongst the South African population over past the 10 years, no studies could be found that examines how cognitive development has been impacted, (World Bank, 2023).

Digital intelligence which is argued to be the intelligence required for the digital age is said to include knowledge of how to manage business strategies, governance, projects, and enterprise systems, in addition to the ability to operate Information Technology (IT), (Mithas & Smith, 2017). This seems to suggest that there may be a case for DQ to be a facilitator of DT in South African organisations.

a. *DQ and South African Industries*

Literature on digital transformation in South Africa indicates that digital transformation is an industry-wide phenomenon in South Africa. Grasser, Schlaipfer, Priedl, and Sorantin (2018), explain that digital transformation is one of the most significant problems facing the healthcare industry in its efforts to support healthcare ecosystems. A paper by Gaffley and Pelser (2021), focuses on the creation of a model to facilitate the development of digital transformation strategies in the manufacturing industry. South Africa's retail, tourism, education, and financial sectors are undergoing significant digital transformations,

necessitating digital transformation plans to maintain competitiveness, (Bijlani, 2021; Boratyńska, 2019; Mhlanga & Moloi, 2020; Schoeman, Bick, & Barnardo, 2021). It can be put forward that the improvements to access to the internet in South Africa and the proliferation of services that have become available through digital means in South Africa is evidence of these assertions, (World Bank, 2023).

However, despite the importance of DT to South African industries and the advances that have been made, it is argued that South Africa is still lagging in the transformation of some industries (Maremi, Thulare, & Herselman, 2022). **Figure 1** below is an example that shows the extent to which South African organisations in the mining industry have progressed in implementing digital technologies. **Figure 1** shows that technologies such a Virtual Reality (VR) and predictive maintenance are fully embedded in the mining industry. However, other digital technologies such as artificial intelligence, robotics, and blockchain are either partially implemented or planned for the future. Research focusing on the influence of social activities such as gaming on the development of digital cognitive competencies which are needed by South African workers to enable the digital transformation of organisations is still lacking.

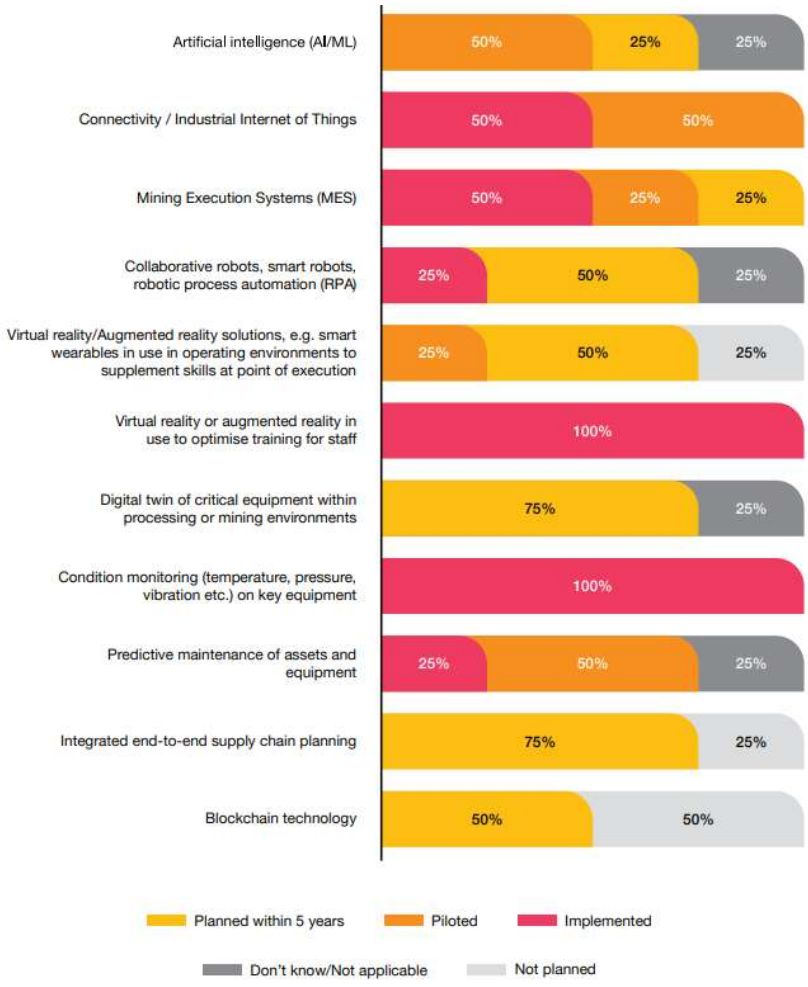

Figure 1: Technology Implementation in the South African Mining Industry (PwC, 2023)

According to findings by Grasser, Schlaipfer, Priedl, and Sorantin (2018), people are the most significant aspect of a social-economic transformation model, with the rationale being that people create and influence businesses. The social-economic relationship focuses on how society interacts with the different dimensions of the economy, (Lekule, 2022; Rwigema, 2020). Observing the arguments by Grasser, Schlaipfer, Priedl, and Sorantin (2018), in the context of the prevalence of DT in South Africa, it can be put forward that, the interactions between gaming which is a societal practice and the digital economy is key to understanding how gaming is influencing social-economic transformation across South African organisations.

b. ***DQ and Gaming***

Battr (2009), emphasises that because of the digital revolution, we are now confronted with a difficult challenge regarding new methods of teaching and learning in a digital environment. The core principle of Piaget's constructivist theory is that humans continuously build cognitive structures that, when they reach a certain degree of stability, serve as the basis for the next step or stage (Battro, 2009 cited by Papert 1986). These assertions point to the need for the continuous evolution of learning and cognitive abilities.

Battro (2009), and Papert (1986), do not, however, clarify in any detail the link between the difficulties of the ongoing creation of cognitive structures and digital competency. Gaming has been shown to improve cognitive abilities. By conducting this study, some of the possible links between gaming and digital cognition were examined. This adds to theories put forward by various scholars who affirm that gaming may facilitate the development of cognition during the digital era and by extension, in South African organisations, (Choi, Shin, Ryu, Jung, Kim, & Park, 2020; Denilson et al., 2019; Jordan & Dhamala, 2022; Quiroga, Diaz, Román, Privado, & Colom, 2019).

2.3.3 ***Hypothesis (H1)*** *–There is a positive relationship between gaming experience and elements of DQ.*

2.3.4 ***Gaming Benefits to cognition***

Numerous studies have emphasized the possible advantages and disadvantages of playing online and offline video games, based on a wide range of psychological markers and mental health consequences, (Holmer, Rudner, Schönström, & Andin, 2020; Sharma, Biswas, & Anand, 2021). Gaming or video gaming refers to an individual’s practice of playing electronic video games, (Denilson et al., 2019). This definition is adopted in this study. Reference to gaming in this study is not the usage of elements of game design in non-gaming contexts such as in education, training, and marketing, otherwise known as gamification (Sailer & Homner, 2020).

Studies examining gaming in deaf signers revealed that individuals with gaming experience had improved visuospatial control than those without gaming experience. (Holmer et al., 2020; Qiu, Ma, Fan, Zhang, Li, Yan, Zhou, Li, Gong, et al., 2018). These studies and others reflect the expanding body of evidence that suggests connections between gaming experience and cognitive and brain benefits.

a. *Gaming Benefits to Decision-making and Problem-solving*

Findings by Jordan and Dhamala (2022), indicate that due to brain alterations, gamers demonstrate enhanced performance in decision-making. The research does not, however, attempt to explain how these findings may be applied to the digital world. A similar study by Sun et al. (2022), discovered that individuals with greater gaming expertise had higher levels of computer-based problem-solving. Although the findings by Sun et al. (2022) are useful from a technology perspective, the study used the problem-solving assessment framework of the Programme for International Student Assessment (PISA). PISA, emphasizes problem-solving technical skills and does not include emotional and social elements, as is the case with DQ. Further understanding of the benefits of gaming in relation to a multi-factored framework such as DQ is required.

b. *The Negative effects of gaming*

Other research in the field of gaming experience has concentrated on the negative sides of gaming, such as addictive behaviours, poor social skills, depression, and violence, as well as Internet gaming disorder. (IDG), (Akbari, Bahadori, Bouruki Milan, Caselli, & Spada, 2021; Aydın, Güçlü, Ünal-Aydın, & Spada, 2020; Casale, Caponi, & Fioravanti, 2020; Casale, Musicò, & Spada, 2021; Gandolfi, Soyturk, & Ferdig, 2021; Sublette & Mullan, 2012; Yu, Mo, Zhang, Li, & Lau, 2020). These authors concur that video games may lead to addiction and behavioural issues. Contrarily, Hartanto, Lua, Quek, Yong, & Ng (2021), suggest that the literature on gaming and well-being is rife with inconsistent findings and that context must be provided when evaluating this link.

The possible negative consequences of gaming are important and should not be ignored. They should rather serve as a guide to avoiding and reducing the unintended harmful effects that gaming may have. Despite the conflicting polarities on the impact of gaming on the brain, the researchers seem to agree that cognition and the brain are altered by gaming in one way or the other. The inability of the authors to completely understand the mechanisms causing cognitive and brain changes points to a knowledge gap, (Sublette & Mullan, 2012).

Both the positive and negative views on gaming appear valid in the context of the objectives of the respective studies. How a person or organisation learns to solve problems may influence the problem-solving strategies they choose. Conversely, knowledge gained from gaming may influence the strategies that organisations adopt for competency development. The next section examines the literature on gaming experience.

2.3.1 ***Hypothesis (H1) –****There is a positive relationship between gaming experience and elements of DQ.*

2.3.2 ***Gaming Duration***

Gaming experience can be expressed as the amount of time spent by an individual engaging in playing video games over time. Gaming duration can be paralleled to the sensory stage of the information processing model where input is received from the game to the brain. Kulworatit (2021), finds significant and substantial links between gaming experience and problem-solving performance among gamers with seven or more years of experience. Smith, Bhaskar, Hinerman, and Basak (2020), support the conclusions of Kulworatit (2021), surmising that video games and cognitive skills create a larger capacity for learning other complex activities such as problem-solving.

The number of hours per week spent playing video games was shown to be a predictor of learning in research conducted by Smith, Bhaskar, Hinerman, and

Basak, (2020). Smith et al. (2020), citing research demonstrating that gamers who play at least three hours per week have greater cognitive abilities than novices. Evidence from the studies by Smith et al. (2020) and Kulworatit (2021) add to findings from the study by Smith et al. (2020), suggesting that the number of hours and years spent playing video games has a beneficial influence on cognitive abilities. In addition to these findings, Qiu et al. (2018) reported cognitive alterations in subjects after only one hour of playing action video games. However, it could be argued that the results reported by Qiu et al. (2018) may have been the consequence of cognitive gains deriving from short-term working memory rather than long-term permanent memory, which is of greater significance to this study.

The studies by Smith et al. (2020) and Kulworatit (2021) focused mainly on the relationship between gaming experience and cognitive abilities about learning theory and the learning-to-learn hypothesis. Literature suggests that most of the studies examining gaming and cognition tend to use experimental methods to examine this relationship. Little evidence could be found of studies that used historical gaming experience over longer periods to establish the linkages between the two. Gaming duration is a component of gaming. The longer the gaming duration, the more input is provided to the brain at the sensory stage of the information processing model shown in the adapted Information processing model in **Figure 1** of section **2.5.3**.

Assertions by Kulworatit (2021), Mithas and Smith (2017), and Qiu et al. (2018) suggest that gamers must engage in playing games frequently to develop experience. It is therefore important to understand gaming frequency in terms of the second stage of the information processing model due to repetition of play. It should be noted that this element of gaming can also have negative side effects on the gamer, such as gaming addiction, (Inoue, Fujita, Takeshita, Hashioka, & Kamura, 2022).

2.3.1 ***Hypothesis (H2) -*** *There is a positive relationship between gaming duration and elements of DQ.*

a. ***Gaming intensity***

Smith et al. (2020) study the association between new game learning and gaming frequency. Quiroga, Diaz, Román, Privado, and Colom (2019) subjected individuals to numerous game styles played at various levels to evaluate links to general intelligence. According to Denilson et al. (2019), the repeated play of different types of video games gives distinct positive benefits. Highlighting the importance of gaming frequency when examining its cognitive benefits.

Another study by Quiroga et al. (2019), found strong associations between video game performance and IQ, with cognitively taxing games that require repeated application, exhibiting stronger correlations. The study however employs a small sample size and limits gameplay to 90 minutes. The impact of gaming on cognition in the long term also needs to be understood to understand its possible implications on lifelong learning. The study's findings, however, give important insights into how particular game types may be linked to cognitive gains.

Gaming frequency multiplied by gaming duration results in gaming intensity, (Altintas, Karaca, Hullaert, & Tassi, 2019). Gaming intensity can provide a factor for analysis of an individual’s gaming experience. Examination of literature about the different types of games and cognition is outlined in the next section.

a. ***Types of video games***

Modern video games, especially strategy, simulation, puzzles, first-person shooters, and multiplayer online battle arenas, demand highly developed analytical, visuospatial, and problem-solving skills, (Sharma et al., 2021). Numerous scientists have studied how game types affect cognition. Jordan and Dhamala (2022), focused on First-Person Shooter (FPS), Real-Time Strategy (RTS), Multiplayer Online Battle Arena (MOBA), and Battle Royale (BR) players games. Denilson et al. (2019), analyse first-person shooting, strategy, puzzles,

3D adventures, and rhythm dance gaming kinds. Smith et al. (2020), focus on action, casual, strategy, FPS, and puzzle games.

Previous studies examined how game types affect cognition. Despite demographic and cognitive disparities, research concurs that game genre affects participant outcomes. Vahlo and Karhulahti (2020), propose that longer gaming sessions involve more hurdles. This suggests that game type may improve short- and long-term memory through obstacles.

Smith et al. (2020) Smith et al. (2020) limit their study on game types and cognition to strategy and action games, citing a neuroimaging study that found distinct brain regions were utilized for action vs. strategy games. This is a weakness in the study in relation to the number of game types that exist. The study could have used the other game types as controls to overcome this weakness.

Reynaldo, Christian, Hosea, & Gunawan (2021), is of the notation that playing certain types of games can improve decisions making and cognitive skills, a paradigm that is discussed below. This assertion can be taken further with the argument that the type of game played may impact specific digital cognitive process development. Therefore, there is a need to examine digital intelligence in relation to specific game types.

b. *Gaming and Problem Solving*

Video gaming frequently demands rapid and repetitive decision-making, and it is believed that it may be used to enhance an individual's performance, (Jordan & Dhamala, 2022; Sun et al., 2022). Adams (2004), argues from a digital work viewpoint that the intellectual growth patterns of individuals are shifting because of their use of digital technology for work, entertainment, and communication. This assertion by Adams (2004), is supported by the assertion that, in the digital world, digital technology is fast changing and largely concerned with solving business problems, some with high complexity that requires decision-making based on human intuition, (Barak & Zadok, 2009; Büyüközkan, Havle, & Feyzioğlu, 2021; Marnewick & Marnewick, 2021a). Similarly, in the digital world,

the brain must contend with alternative and perceptual options, requiring rapid and precise sensorimotor decision-making, (Jordan & Dhamala, 2022).

These assertions may have some merit when considering how different types of games present specific types of cognitive challenges for the gamer. Understanding the relationship between game types may provide input into specialised training design that requires equally specific cognitive capabilities.

2.3.2 ***Hypothesis (H3) –*** *There is a positive relationship between gaming intensity and elements of DQ.*

2.4 Demographic factors and the relationships between gaming and DQ?

This section of the literature review discusses the second sub-question of the study. Its focus is on the themes of, age, gender, ethnicity, education, and marital status. Literature is examined on demographics as certain demographics appear to determine the practice of gaming, (Ankara & Baykal, 2022; Wang & Cheng, 2021).

2.4.1 *Demographic Factors*

a. *Age*

Engelstätter and Ward (2022), state that gaming has become increasingly popular among 19- to 40-year-olds who are more educated, middle-class, and ethnically diverse. A rising number of people, especially young people throughout the world, are believed to prefer playing video games over physical pastimes (Sharma et al., 2021). There are also assertions by several authors who argue that ‘g’ changes with age (Breit, Brunner, & Preckel, 2020; Breit, Brunner, & Preckel, 2021; Molenaar, Dolan, Wicherts, & van der Maas, 2010; Tucker-Drob, 2009 as cited by Demetriou et al, 2022). If these assertions are to be believed, then age may play a role in cognitive development or the interest in gaming.

Links between gaming experience and DQ in certain age groups could inform the development of more suited specialised training programs that are in line with a particular age group. Younger males for example may gravitate more to shooting games that show their ability to fight.

b. *Gender*

Reynolds, Hajovsky, and Caemmerer (2022) argue that there are no differences in the general intelligence of males and females. However, Yang, Quadir, and Chen, (2018), cite several studies that demonstrate the significance of human elements such as prior knowledge and gender differences in digital game-based learning. The study by Yang, Quadir, and Chen, (2018), is however not clear what its assumptions are on the gender differences found in these studies. Reynolds et al. (2022), puts forward a plausible explanation for the existence of such differences stating that these may be a result of environmental and socio-economic factors. Understanding differences and why they exist will enable appropriate corrective interventions to be taken. South Africa still has discrepancies in the opportunities offered to males vs females including in the workplace, (Casale & Posel, 2021). Therefore, examining how gaming impacts DQ in the context of gender amongst South African white-collar workers, provided insights into whether such differences exist from a South African perspective.

c. *Ethnicity*

Richardson (2022), claims that even in the present era, there are still influential people who believe that some races are cognitively superior to others and that males are intellectually superior to women. Although the assertions by Richardson (2022) may hold some merit, it is gaming experience across the different ethnic groupings that are more relevant to this study. Disparities in gaming intensity and DQ across ethnic groupings may indicate that other socioeconomic factors, such as differences in affluence, moderate these correlations. This argument requires testing especially in the South African context where the historic consequences of apartheid practices still exist today, (Dilraj, 2021; Fourie & Jayes, 2021; Nwosu & Oyenubi, 2021).

d. ***Education***

Fletcher, Topping, Zheng, and Lu (2021), found that education impacts cognition in later life. Although the study is conducted to assess the effects of education on cognition in relation to Alzheimer's disease, its findings are significant. These findings are supported by Chen, Lv, Li, Zhang, Chen, Liu, Li, Fan, Qin, et al., (2019), who present results showing wider cognitive functionality in individuals with higher educational achievements. Although both these studies were conducted on participants drawn from older age groups ranging from 39 to 68, they do provide the basis for examining this relationship in the context of gaming and DQ. The implications of such a relationship could further inform interventions for learning development.

e. ***Marital Status***

Using data from the United States, a study on how gaming has become more mainstream in society draws some conclusions on the demographic composition of gamers in the digital era which may be a pointer on the interaction between marital status and gaming, (Engelstätter & Ward, 2022). The study reports subgroups of participants displayed the conventional picture of gamers as solitary individuals who play for extended periods while living with their parents, (Engelstätter & Ward, 2022). It is assumed that gamers who are not married are more likely to exhibit higher gaming intensity than those who are, (Wang & Cheng, 2021). Therefore, individuals that engage in longer periods of gaming were expected to be single.

2.4.2 ***Hypothesis (H4) –*** *Some demographics moderate the relationship between gaming and elements of DQ.*

2.5 ANALYTICAL FRAMEWORK

This section outlines the theoretical concepts underpinning the constructs of this study. Earl Hunt asks the question, "how can we speak of who thinks well until we have a clear understanding of what thinking means to us", (Hunt, 1980 p 449).

This study is guided by the paradigm from Earl Hunt's assertions. It is grounded in two theories that will enable the brief exploration of paradigms about what "thinking" or cognition is in the context of the digital age, and whether gaming impacts digital intelligence during this digital era.

2.5.1 *Theoretical Framework*

This study is informed by two theories, the information processing theory concerning cognition as outlined by Lachman, Lachman, and Butterfield, (2015), and the theory of multiple intelligences that was popularized in managerial circles by Karen Goldman and Howard Gardner,(Gardner, 2011; Goldman & Schmalz, 2003).

2.5.2 *Multiple Intelligence Theory*

Gardner (2011), contends that human development is very elastic and adaptable and that various interventions can influence the intellectual abilities and potentials of an individual or a group. By extending Gardner's argument to gaming, which has become ingrained in the digital ecosystem, it is fair to assert that gaming, which is a digital construct, could influence the transformation of an individual's digital cognitive skills and potential when used as an intervention.

Multiple intelligence theory argues that, human cognitive ability is multifaceted, and that human capabilities cannot be combined into a single measure, (Bernreuter & Goodman, 1941; Gardner, 2011; Goldman & Schmalz, 2003; Guilford, 1967; Neisser et al., 1996; Spearman, 1927; Thorndike, 1920).

Multiple intelligence theory further asserts that individuals who demonstrate particular levels of cognitive ability in one intelligence may not demonstrate the same level of cognitive ability in another intelligence and that it requires the use of appropriate observational tools to reveal the true nature of each intelligence with sufficient clarity, (Gardner, 2011).Therefore, it can be put forward that to understand the development of the digital cognitive intelligence amongst South African workers, an appropriate lens must be applied in the form of the Digital

Intelligence Quotient (DQ) (DQInstitute, 2017; IEEE, 2021; Marnewick & Marnewick, 2020; Na-Nan et al., 2020; Thomson, Futcher, & Gomana, 2019). This study used a questionnaire adapted from Na-Nan, Natabang, and Wongsuwan (2020), to measure DQ across the eight digital competencies of digital intelligence as set out by the DQ institute (IEEE, 2021; Kulworatit, 2021; Na-Nan et al., 2020; Rahman et al., 2021). Na-Nan, Natabang, and Wongsuwan (2020) list these eight dimensions as:

I. Digital identity (identity)
II. Digital Use (use)
III. Digital Safety (safety)
IV. Digital Security (security)
V. Digital emotional Intelligence (emotional)
VI. Digital communication (communication)
VII. Digital Literacy (literacy)
VIII. Digital Rights (rights)

As stated, before the DQ framework, however, contains some questions that may be rudimentary in their construct and may require adaptation to the assessment of DQ in a business setting. The South African socioeconomic factors must be taken into consideration when examining the results of the study. This is in line with similar research conducted by other researchers on digital intelligence, (Kulworatit, 2021).

2.5.3 *Information Processing Theory*

The Information Processing paradigm is concerned with how humans collect, store, modify and interpret the information in their environment or the information they have previously stored (Lachman et al., 2015; Schmeichel et al., 2003). Simplification of the theory reveals three broad stages of cognition, that is sensory memory, short-term memory, and long-term memory (Çeliköz, Erişen, & Mehmet Şahin, 2019; Huitt, 2003; OHLSSON, 1984; Shiffrin & Atkinson, 1969; Swanson, 1987).

In short, information processing theory sets out processing stages from stimulus to outcomes (Snow, Federico, & Montague, 2021). However, the Information Processing theory in its simplest version is limited in its description of the results of cognition, focusing instead on the cognitive processes themselves. This has resulted in the emergence of sub-theories such as the Managerial Information Processing theory, which examines the effects of managerial decision-making and problem resolution, (Ungson, Braunstein, & Hall, 1981). Nass and Moon (2002), put forward the argument that the association between individuals and digital environments is a social interaction known as computers-as-social-actors (CASA). Mayer (2001) supports this paradigm stating that social cues in digital media give the impression of a social presence and trigger the social response system in the individual. The Cognitive-Affective-Social Theory of Learning in Digital Environments (CASTLE) is an extension of the CASA theory suggesting that factors outside of gaming may play a role in the development of digital cognition (Schneide, Beege, Nebel, Schuabert, and Rey, 2021).

This study seeks to examine the relationship between gaming and DQ as an outcome. Therefore, the information processing theory is selected as the theoretical framework to guide the study of the relationship between the two variables of gaming and DQ. The Adapted framework in **Figure 1** shows the process of cognitive development from gaming stimulus (*a*) to the outcome in the form of DQ (*d*). The theory enables the examination of the development of digital cognitive benefits of gaming through the four constructs of, sensory memory, short- & long-term memory, and outcomes. As Shown in **Figure 1**, the four constructs of gaming which are gaming experience (*a*), gaming duration (*b*), gaming frequency (*c*), and outcomes (*d*) correspond to the stages of the information processing model when overlayed over the model.

According to Lutz and Huitt (2018), the four broad stages of the information processing theory are as follows:

a. ***Sensory Memory***

Sensory memory is the first step in the cognition process. During this step, an individual receives a stimulus or stimuli through their senses. In the digital world, digital stimulus or stimuli is received through analog interfaces in the form of displays, sounds, keypads, and digital devices, illustrated as part '***a'*** in **Figure 1**, (Armstrong & Lee, 2021). From the perspective of gaming, this stage is represented by whether an individual participates or has participated in gaming in the past i.e., has gaming experience. It is only when a video game has provided the input to an individual's sensory memory through a digital device that they may be considered to have possibly had some cognitive gains and therefore may be categorized as individuals who have gaming experience. It is therefore important to understand if gaming experience influences the development of DQ.

b. ***Short- Term Memory***

This research incorporates the short- and long-term memory stages of the cognitive process. Short-term memory is commonly referred to as active or conscious memory. It is the component of memory that is actively processing new information received from sensory memory or the game. Short-term memory has an extremely limited capacity, and if no additional action is taken, unrepeated information is lost (Huitt, 2003). From a gaming perspective, this is represented by '***b***' in **Figure 2** which is gaming frequency. During this stage of the information processing model, a lack of repetition, in this case, the playing of video games over and over, may lead to a loss of information or skills acquired. It is therefore important to understand if gaming frequency has the same influence on the development of DQ in individuals.

c. ***Long-Term Memory***

Repetition is important for long-term retention and permanent change requires new knowledge to be incorporated into long-term memory through repeated play as shown in **Figure 2** below. Repeated play adds up to longer periods of engagement in an activity. In the context of gaming, repeated play leads to a longer duration of gaming. Repetition alone though is argued to be insufficient to

establish a long-term impact (Lutz & Huitt, 2018). Therefore, the influence of gaming duration on the development of DQ needs to be examined.

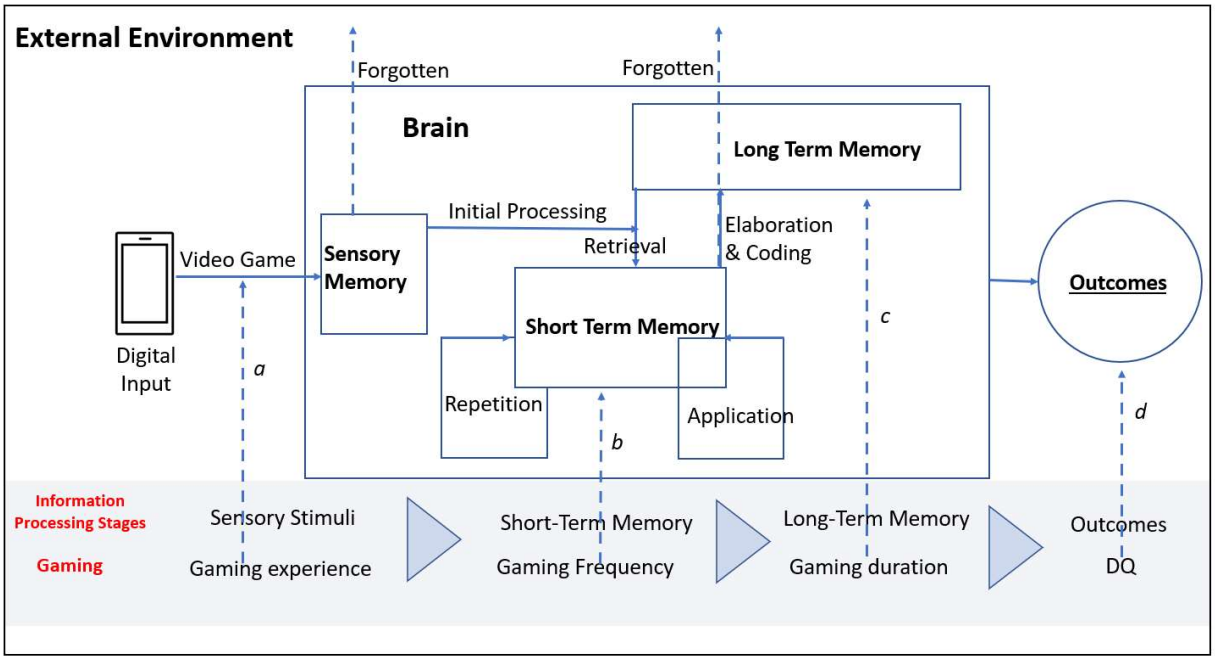

Figure 2: The information processing model. adapted from (Lutz & Huitt, 2018)

d. ***Outcomes***

The expansion of cognitive learning theories highlights learning as being reliant on motivational, metacognitive, and emotional processes in addition to how information is processed in the brain (Schneider, Beege, Nebel, Schnaubert, & Rey, 2021). Gaming is argued to have cognitive benefits. DQ has been argued to be an outward projection of digital cognitive ability. Therefore, it is important to understand if DQ is an outcome of the information processing model, with gaming as the input as illustrated in **Figure 2** part '*d*'. **Theoretical framework Conclusion**

The two theories that guide this study provide the framework for the study of digital intelligence and gaming. They are the Multiple Intelligence theory and the Information processing theory. The study follows the constructs provided by the four stages of the information processing theory and the eight dimensions of DQ

to assess the relationship between gaming and DQ. The application of these theories will give the necessary understanding of how gaming influences DQ, hence influencing the creation of competence development solutions that may assist organizations in navigating their particular digital transformation paths, (Eliasmith, 2001 as cited by Lutz & Huitt, 2018).

2.5.4 *Conceptual Framework*

Figure 3 below outlines the conceptual framework of the study.

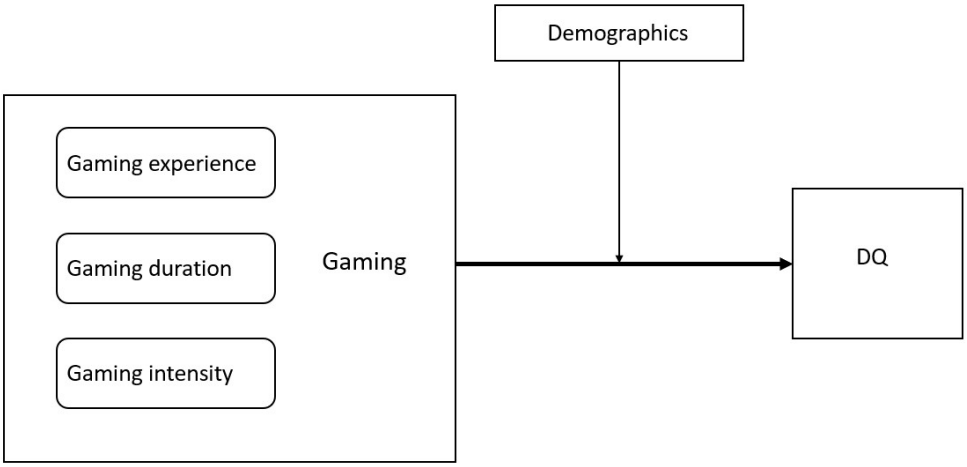

Figure 3: Conceptual Framework (Author, 2023)

Figure 3 shows how gaming experience, duration and intensity are elements of the construct of gaming. In the diagram, gaming is the independent variable that leads to the development of the dependant variable, DQ. Demographics moderate the relationship between gaming and the development of DQ in individuals, (Alfaifi, Mahmoud, Elmahdy, & Gosadi, 2022; Ankara & Baykal, 2022; Wang & Cheng, 2021). This study hypothesizes that the more gaming experience, the long they game, and the higher their gaming intensity, then the more the individuals DQ will develop. This study uses the DQ variables of identity, use, safety, security, communication, emotional, literacy, and rights as the elements that make up the dependant variable (DQ).

2.6 Conclusion of Literature Review

Literature review findings reveal that gaming affects cognition and the brain. The cognitive benefits of gaming cannot be overlooked. The management challenges posed by technological advancement continue to increase. Among these challenges is the development of 21st-century-appropriate competencies in both approach and content. Additionally, the literature argues for DQ, indicating that DQ is the competency of the 21st century. There exists an opportunity to further investigate how gaming influences digital cognitive development. Could some of the answers to digital cognitive development lie in the digital technologies themselves, such as gaming? Relationships between gaming and DQ could inform the design of specialised training and inform management recruitment methods. This study intends to shed light on these linkages among the South African workforce and aid in the development and enhancement of current management recruitment and training practices.

Hypothesis (H1) *- There is a positive relationship between gaming experience and elements of DQ.*

Hypothesis (H2) – *There is a positive relationship between gaming duration and elements of DQ.*

Hypothesis (H3)- *There is a positive relationship between gaming intensity and elements of DQ.*

Hypothesis (H4) – *Some demographics moderate the relationship between gaming and elements of DQ.*

CHAPTER 3. RESEARCH METHODOLOGY

This chapter outlines the strategy that was employed by the study to answer the research question. The research methods outlined in this chapter were selected on the criteria that they were the best suited to enabling the successful completion of the study and answering the research question, (Ratelle, Sawatsky, & Beckman, 2019). The chapter outlines the choices made in the following research steps: approach, design, data collection, population, sample, sampling, instrument, data analysis, validity, reliability, and considerations of the ethics of this study.

3.1 Research approach

The literature review revealed the formalization of digital intelligence and research stating that gaming may improve intelligence or cognition. The link between these two phenomena is still not fully understood. The quantitative method was used to address the research question concerning the phenomenon's reality. The study aimed to address the reality of the relationship between gaming experience and digital intelligence by addressing issues such as what the relationship is and where it occurs, (Apuke, 2017). The study did not aim to understand how participants' feelings toward gaming or their perspective on gaming, hence the qualitative approach was not selected. Using the quantitative approach enabled the collection of statistical and numerical data and the analysis of that data using systematic and empirical means to answer the research question, (Basias & Pollalis, 2018).

3.2 Research design

The deductive method of inquiry was used to logically, empirically, and critically test hypotheses, (Bergdahl, &, Berterö, 2015). Online Surveys were selected as they enabled the collection of quantitative data upon which mathematical and statistical methods were used to draw results and answer the research question, (Saunders, Lewis, & Thornhill, 2011). An online survey was used because it

provided more control over the research process and was more suitable for cross-sectional data gathering, (Saunders et al., 2011).

3.3 Data collection methods

Survey/Questionnaire

The study used an online survey questionnaire as it allowed for the construction of questions that addressed the objectives of the research study. An online questionnaire also allowed for the distribution of the survey to participants that are geographically dispersed across South Africa.

The questionnaire was made up of closed predetermined answers that address the research question drawn from the themes in the literature review. The online questionnaire approach enabled participants to complete the survey with the least amount of effort (Saunders, Lewis & Thornhill, 2003).

The following process was followed to collect data:

i. An online survey was created on Qualtrics.
ii. The survey was pretested with a handful of the sample.
iii. A link to the online survey was distributed to participants using email, social media platforms (LinkedIn) and WhatsApp.
iv. Responses were collected online after which they were downloaded and analysed.

3.4 Population and sample

3.4.1 *Population*

The study population of this study was white-collar workers in South Africa who correspond to the population of interest. This population was selected because it was deemed the population that was representative of the South African workforce in South African organisations and largely concerned with the digital

transformation in organisations. The population included white-collar workers who are both employed and unemployed of legal working age. It was not possible to evaluate the entire population of South African white-collar workers, therefore, a sample was selected from the population for evaluation.

3.4.2 *Sample and sampling method*

Nonprobability convenience sampling with snowballing was used for this research. Convenience sampling provided a practical way of reaching the targeted population under the time constraints of the study. Snowballing complemented convenience sampling by encouraging participants to recruit participants within their networks.

A sampling frame consisting of 2 500 possible participants was used with a target of reaching 10% or a sample size of +200. The sample size was deemed appropriate due to the practical constraints of time and resources under which the research was conducted.

Participation was limited to individuals who have South Africa as their geographic location on LinkedIn. Participants were selected from the researchers network on linkedin, email address book and whatsapp contacts to target those individuals with South African identifiers. All participants were encouraged to share the survey with other white collar workers within their professoinal circles.

3.5 The research instrument

Survey questions were administered through an online questionnaire developed specifically for the research study. In keeping with the literature review, the themes of the survey were gaming experience, DQ, and demographics. The questions were simple to enable participant comprehension. The questions were self-completion, requiring a single decision for each.

A pre-test was conducted with a small number of test participants who were representative of the sample group. This provided an opportunity to resolve any errors or problems that may be picked up before the survey was administered.

The online survey was made up of three sections as follows:

i. **Section A**

   This section is concerned with gaming experience. The questions in this section answered the question about the participants' gaming experience following the themes of gaming frequency, duration, and intensity.

ii. **Section B**

   This section relates to measuring the participants' DQ following the eight DQ themes as outlined in section 2.3.1.

iii. **Section C**

   Pertains to the demographics of the participants as identified in the literature review.

Although every effort was taken to keep the survey as short as possible, section B of the survey was still longer than what would have been preferred. This however was necessary to give a complete DQ measure. See **Appendix A** for the cover letter to all participants and **Appendix B** for the complete research instrument.

3.6 Data analysis strategies and interpretation

Only primary data was used for this study. Once the data was collected using Qualtrics, it was analysed and processed to test hypotheses made in the literature review using SAS Studio.

Parametric statistical tests were applied and descriptive statistics were carried out using Confirmatory factor analysis, Cronbach’s alpha to test reliability and validity, and structural equation modelling to investigate gaming leads to DQ.

Moderation analysis was used to test the moderations using the Baron and Kenny method, (Baron & Kenny, 1986). Multiple linear regression was used to measure the strength of the relationships.

These statistical techniques enabled conclusions to be drawn concerning these hypotheses. The data analysed using the four steps below:

1. **Coding of the data -** Categorization and checking the data.
2. **Initial data exploration** – Checking for normalisation and missing data
3. **Analysis of the data** - Using statistical tests as mentioned above to answer outlined hypotheses.
4. **Data display and representation** – Interpreting the statistical findings through tables and graphs.

3.7 Limitations and challenges of the study

The following were identified as possible limitations and challenges to the study:

- The study was limited to a single population group which was white collar workers.
- The respondents did not have equal representation of gamers and non-gamers.
- Participants may have been self-bias when they respond to the questionnaire.
- The survey questions in Section B on DQ were administered in a different cultural setting to previous studies. The South African cultural, economic, language and political context will have to be taken into account when concluding the data (Na-Nan et al., 2020).

3.8 Quality Assurance

3.8.1 *External validity*

External Validity is the extent to which the results of the study can be generalized to bigger groups or conditions (Gray, 2014). The main research question of this study aimed to examine the relationships that exist between two phenomena in white-collar workers, gaming and DQ. The study sample was representative of the demographic of white-collar workers in South Africa and therefore the results of the study can be generalized to South African white-collar workers, meeting the requirements set out by (Campbell and Stanley, 1963).

3.8.2 *Internal validity*

A literature review was undertaken to establish if what was measured in the study was reflective of the real world (Ratelle et al., 2019). Section A was the demographics section, and it does not measure any new criteria beyond those already examined in earlier research. The questions in Section A quantify gaming experience, and they were based on questions from earlier research that examined gaming experience. Section B was a DQ measure that was adapted from Na-Nan et al. (2020).

The literature review guided the construction of the research instrument to ensure that the questions of the survey answer the research question. The study used graphs and charts that were derived directly from the source tables containing the data. The data was collected using standard data collection practices and kept secure in an online location (Qualtrics) should a third party require them.

3.8.3 *Reliability*

The study used a questionnaire adopted from Na-Nan et al. (2020). In addition, an Excel spreadsheet was used to construct a chain of evidence to increase the

data's reliability, allowing an external observer to track the steps in either direction, thereby satisfying the criteria set by Yin, (2003).

3.9 Ethical considerations

Ethics is the norms, principles, and standards of conduct governing this study, (Trevino & Nelson, 1999). The study has ensured that it meets the moral responsibility to carry out its research honestly and accurately, (Wilson, 2014:91). Due consideration has been given to ethical requirements of confidentiality, anonymity, informed consent, no harm to participants, and obtaining permission.

3.9.1 *Confidentiality and Anonymity*

The fundamental elements of life in a democratic society include the right to privacy, which includes the safeguarding of confidentiality and anonymity (Gray, 2018). The study protects these rights by :

- Ensuring that all participants will complete the survey anonymously. The link was sent electronically and did not have the capability of collecting any information that identified participants.
- No information that can be used to identify a participant was collected.
- All data collected was kept confidential on a password-protected computer and in access controlled cloud platform.
- No labels or descriptions of the sources of the data were used in the correlation and analysis of the data to ensure anonymity.

3.9.2 *Informed Consent*

The participants of the study were informed as far as possible about the nature of the research and the data to be collected before they start the survey. This was necessary to meet the commitment of providing participants with sufficient information about the study so that they may decide whether to participate, (Crow,

Wiles, Heath & Charles, 2006). The online survey only proceeded upon the participant giving their consent to participate online.

3.9.3 *No harm to participants*

A study may be deemed harmful if it causes participants to experience embarrassment, ridicule, belittlement, or overall mental discomfort, (Subman, 1998). Participants were assured before administering the questionnaire that the results of the study were used for no other purpose but academic research. All reasonable steps were taken to ensure that research questions were nonintrusive. Additionally, the data collected was kept confidential.

3.9.4 *Obtaining Permission*

Permission was requested at the start of the survey by alerting participants that by continuing with the survey, they were consenting to participate in the research. This conforms to the requirement that formal channels be cleared to undertake the research, (Cohen, Manion, & Morrison, 2018).

CHAPTER 4. PRESENTATION OF RESULTS

4.1 Introduction

This chapter reports and describes the results of the study outlined in Chapter 3. Parametric statistical tests were applied, and descriptive statistics were carried out. The chapter describes the characteristics of the sample used in the statistical analysis of the responses received. This is followed by a presentation of the demographics of the participants. The presentation and description of reliability and validity tests using Confirmatory factor analysis (CFA) and Cronbach's alpha to provide internal consistency and reliability measures. A presentation of multiple linear regression models measuring the predictors of the eight DQ domains then follows. The results of the moderation tests that were carried out using the Baron and Kenny method are then presented. The Chapter concludes with the findings and summary of the tested hypotheses.

4.2 Sample Characteristics

The online survey generated 292 responses in total. There were 230 replies overall after 62 responses that were either blank or had more than 10% missing data removed from the sample (Little & Rubin, 1989). The demographic factors utilised in this study are described statistically in the sections after.

4.3 Survey Descriptive Statistics

Table 1 below shows the survey's descriptive statistics for identification, use, safety, security, emotional, communication, literacy, and rights. Each variable has a label and a code that starts with a letter for the construct it belongs to and a number for the specific question inside that construct (e.g., Q8 for identity, Q9 for use, etc.).

The MEANS Procedure

Variable	Shortened Refrence	Label	Mean	Std Dev	Minimum	Maximum	Skewness	Kurtosis	N Miss
Digital Identity	identity	Q8_1	4.4308943	2.3002442	1	7	-0.421764	-1.4863198	24
Digital Identity	identity	Q8_2	4.4593496	2.3097782	1	7	-0.4895833	-1.4324658	24
Digital Identity	identity	Q8_3	3.6829268	1.9807938	1	7	0.1070738	-1.3611153	24
Digital Identity	identity	Q8_4	5.5447154	1.9134413	1	7	-1.390729	0.669342	24
Digital Use	use	Q9_1	4.2222222	2.0550281	1	7	-0.2016368	-1.4329538	27
Digital Use	use	Q9_2	4.1769547	1.9342401	1	7	-0.3425701	-1.290836	27
Digital Use	use	Q9_3	5.1646091	1.5446731	1	7	-1.2618763	0.8471031	27
Digital Use	use	Q9_4	4.0987654	1.8245679	1	7	-0.1433223	-1.3071052	27
Digital Safety	safety	Q10_1	5.5188285	1.7842274	1	7	-1.3178873	0.5925693	31
Digital Safety	safety	Q10_2	5.4686192	1.7290336	1	7	-1.2155406	0.359139	31
Digital Safety	safety	Q10_3	5.9288703	1.4692804	1	7	-1.93602	3.4220261	31
Digital Safety	safety	Q10_4	5.5941423	1.9181046	1	7	-1.3106444	0.4238048	31
Digital Security	security	Q11_1	5.4529915	1.3489511	1	7	-1.3436935	1.7977412	36
Digital Security	security	Q11_2	4.1837607	1.8309432	1	7	-0.2743855	-1.1939749	36
Digital Security	security	Q11_3	6.1923077	1.1124465	1	7	-2.8394281	10.1172741	36
Digital Security	security	Q11_4	6.2393162	1.1358351	1	7	-2.7503359	9.2726163	36
Digital Emotional Intelligence	emotional	Q12_1	5.273913	1.5437485	1	7	-1.2574593	1.0730294	40
Digital Emotional Intelligence	emotional	Q12_2	4.8869565	1.6441784	1	7	-0.8936861	-0.0298701	40
Digital Emotional Intelligence	emotional	Q12_3	3.4	1.9771622	1	7	0.3756145	-1.3511531	40
Digital Communication	communication	Q13_1	5.7733333	1.3219304	1	7	-1.9151554	3.9375923	45
Digital Communication	communication	Q13_2	5.3288889	1.4480008	1	7	-1.3017365	1.2117803	45
Digital Communication	communication	Q13_3	5.1333333	1.5641063	1	7	-1.2403994	0.7836658	45
Digital Communication	communication	Q13_4	5.3777778	1.471286	1	7	-1.3445249	1.2668952	45
Digital Literacy	literacy	Q14_1	5.8648649	1.1727408	1	7	-1.9766552	4.9062092	48
Digital Literacy	literacy	Q14_2	5.9954955	0.9536676	1	7	-1.9177272	5.9434545	48
Digital Literacy	literacy	Q14_3	5.5540541	1.2953997	1	7	-1.3930078	1.8012365	48
Digital Literacy	literacy	Q14_4	5.7072072	1.1375302	1	7	-1.6758506	4.1662428	48
Digital Literacy	literacy	Q14_5	5.5855856	1.1413136	1	7	-1.309306	2.4505774	48
Digital Rights	rights	Q15_1	5.8545455	1.2521132	1	7	-1.5669035	2.3655856	50
Digital Rights	rights	Q15_2	5.9545455	1.0631766	2	7	-1.5193074	2.7946152	50
Digital Rights	rights	Q15_3	5.3454545	1.6044252	1	7	-0.9989403	0.0296257	50
Digital Rights	rights	Q15_4	5.0181818	1.6878931	1	7	-0.9659671	0.00444	50
Digital Rights	rights	Q15_5	5.5090909	1.1605813	1	7	-1.2426232	1.9998389	50

Table 1: Survey Descriptive Statistics (Author, 2023)

Each variable's mean and standard deviation show central tendency and variability. The mean score for identification Q8 1 is 4.43, suggesting that participants agreed with that statement above the middle of the scale (which ranges from 1 to 7). The standard deviation of 2.30 shows that individuals strongly agreed or disagreed with this assertion.

Skewness and kurtosis reflect distribution shape, whereas minimum and maximum values show response range. Negative values indicate skewness to the left (i.e., more values to the right of the mean) and positive values to the right (i.e., more values to the left of the mean). The number of missing values (N Miss) for each variable reveals the proportion of participants who did not answer questions varies from 24 to 50.

4.3.1 *Demographic profiles of respondents*

Table 2 below shows the survey participants' demographics. Most respondents were Black (73.97%), followed by White (12.79%), Asian (5.94%), Other (4.11%), and Colored (3.2%). The gender variable shows that 53.88% of respondents were female, 44.29% were male, and 0.91% were non-binary/third gender or preferred not to say.

Variable	*Frequency*	*Percent*
Race		
Asian	13	5.94
Black	162	73.97
Colored	7	3.2
Other	9	4.11
White	28	12.79
Female	118	53.88
Male	97	44.29
Non-binary / third gender	2	0.91
Prefer not to say	2	0.91
Age		
56 - 63	8	3.65
44 - 55	18	8.22
36 - 43	32	14.61
28 - 35	56	25.57
18 - 27	41	18.72
Gaming		
Non Gamers	18	7.83
Gamers	212	92.17
Education		
Below Grade 12	1	0.46
Certificate/Certification	21	9.59
Diploma	36	16.44
Grade 12	13	5.94
PHD	5	2.28
Post Graduate Degree or Diploma	65	29.68
Under Graduate Degree or Equivalei	78	35.62
Employment		
Full time employee	149	81.42
Independent business owner	13	7.1
Job-seeker	5	2.73
Other	2	1.09
Part time employee	14	7.65
Position		
Executive Manager	10	5.46
Senior Staff	45	24.59
Senior Supervisor/Manager	18	9.84
Staff	80	43.72
Supervisor/Manager	30	16.39

Table 2: Demographic Profiles of Participants (Author, 2023)

Respondents 28-35 (25.57%) had the most respondents, followed by 18-27 (18.72%), 36-43 (14.61%), 44-55 (8.22%), and 56-63 (3.65%). Most respondents (92.17%) were gamers, while 7.83% were non-gamers. Most respondents had an undergraduate degree or equivalent (35.62%) or a postgraduate degree or

diploma (29.68%), followed by diploma (16.44%), certificate/certification (9.59%), grade 12 (5.94%), PHD (2.28%), and below grade 12 (0.46%).

Employment variables include full-time, part-time, independent business owner, jobseeker, and other. Full-time employees (81.42%) outnumbered independent business owners (7.10%), part-time employees (7.65%), jobseekers (2.73%), and others (1.09%). Executive Manager, Senior Staff, Senior Supervisor/Manager, Supervisor/Manager, and Staff are position variables. Staff (43.72%) was the largest group, followed by Senior Staff (24.59%), Supervisor/Manager (16.39%), Senior Supervisor/Manager (9.84%), and Executive Manager (5.46%).

4.3.2 *Business Demographics*

Figure 4 below shows that of the 292 responses in the survey, 230 respondents provided a valid response to the question on the industry they belong to. This demographic information provides an understanding of the characteristics of the participants in relation to South African industries and fulfilling the business demographic requirements of the study.

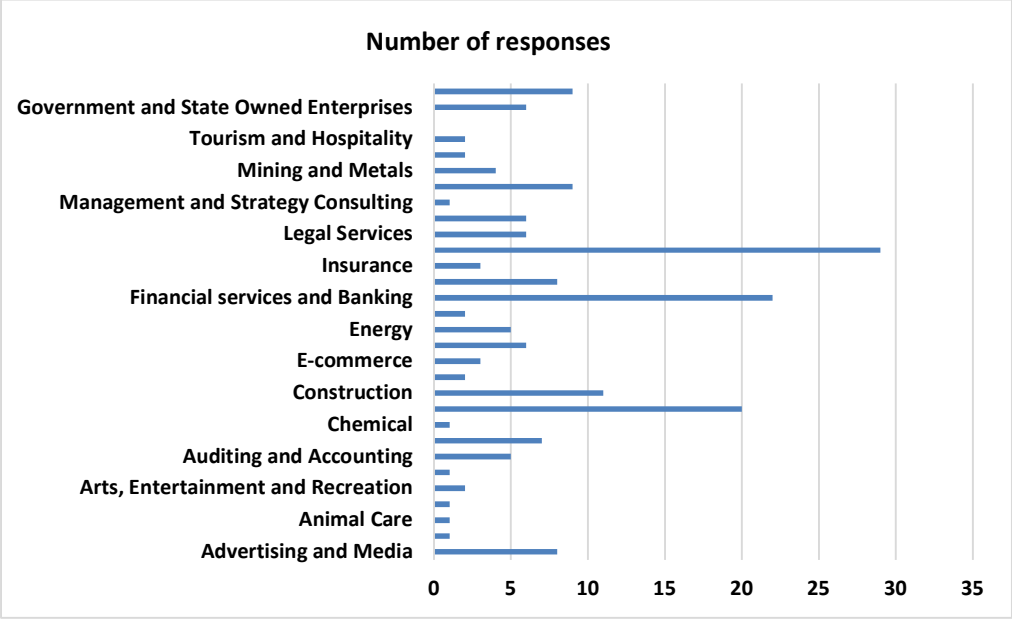

Figure 4: Industry Demographics of Participants (Author, 2023)

4.4 Descriptive Statistics

Table 3 below displays simple descriptive statistics of the variables used to measure DQ in the study. The average mean value of the variables ranges from 2.09773 (Q9_1) to 5.95455 (Q15_2), indicating differences in central tendencies among the variables. Standard Deviation (Std Dev) shows that the variables with higher standard deviations, such as Q8_3 (1.97620) and Q9_2 (1.92493), exhibit greater variability than those with lower standard deviations, such as Q11_3 (0.91567) and q14_comb (0.82129).

The CALIS Procedure
Mean and Covariance Structures: Descriptive Statistics

Variable	Mean	Std Dev	Skewness	Kurtosis
Q8_1	2.27727	1.13735	-0.52959	-1.36564
Q8_2	2.27273	1.15037	-0.56332	-1.34911
Q8_3	3.76818	1.9762	0.04079	-1.36634
Q9_1	2.09773	1.01724	-0.19464	-1.43146
Q9_2	4.13182	1.92493	-0.30964	-1.32144
Q10_1	5.55455	1.76371	-1.33558	0.62287
Q10_2	5.51818	1.67729	-1.22795	0.39256
Q10_3	2.71061	1.14169	-0.73894	-0.31743
Q11_1	5.48182	1.28793	-1.34488	1.95279
Q11_3	2.87697	0.91567	-0.68536	0.39635
Q12_1	5.22727	1.55306	-1.21147	0.89142
Q12_2	4.85455	1.62836	-0.87038	-0.10055
Q13_3	5.12273	1.56043	-1.24493	0.75769
Q13_4	5.4	1.45665	-1.36808	1.36222
Q14_1	2.47485	1.02337	-0.37614	-0.24851
Q14_3	5.55909	1.29726	-1.39173	1.7283
Q15_1	5.85455	1.24926	-1.5562	2.28501
Q15_2	5.95455	1.06076	-1.50893	2.70435
q9_comb	4.67955	1.3102	-0.73931	-0.05824
q11_comb	4.88864	1.41425	-0.73608	0.2731
q15_comb	5.42727	1.12176	-0.8711	0.3845
q13_comb	5.55455	1.13287	-1.54439	3.16443
q14_comb	3.48362	0.82129	-0.53488	0.70252

Note: N = 220

Table 3: DQ Descriptive Statistics (Author, 2023)

Skewness in **Table 3** is a measure of asymmetry indicating that most variables have negative skewness, suggesting a longer tail on the left side of their distributions. The Kurtosis measure of the data distribution shows that most variables have negative kurtosis, indicating flatter distributions with lighter tails compared to a normal distribution.

4.5 Reliability Analysis

Cronbach's coefficient alpha was used to measure internal consistency and reliability. The coefficient alpha ranges from 0 to 1, with higher values indicating greater internal consistency reliability as shown in **Table 4** below under the column “Alpha”.

	Descriptive Statistics							Cronbach Coefficient Alpha	
Variable: identity	N	Mean	Std Dev	Sum	Minimun	Maximur	Label	Variables	Alpha
Q8_1	230	2.2457	1.1481	516.5	0.5	3.5	Q8_1	Raw	0.67673
Q8_2	230	2.2544	1.15	518.5	0.5	3.5	Q8_2	Standardized	0.7531
Q8_3	230	3.713	1.9836	854	1	7	Q8_3		
Variable: use									
`	230	2.1196	1.0279	487.5	0.5	3.5	Q9_1	Raw	0.74079
Q9_2	230	4.1391	1.9284	952	1	7	Q9_2	Standardized	0.77499
q9_comb	230	4.6565	1.3492	1071	1	7			
Variable: safety									
Q10_1	230	5.5348	1.7796	1273	1	7	Q10_1	Raw	0.74682
Q10_2	230	5.4739	1.7274	1259	1	7	Q10_2	Standardized	0.74703
Variable: security									
Q11_1	230	5.4783	1.3338	1260	1	7	Q11_1	Raw	0.59099
Q11_3	230	2.8557	0.9592	656.8	0.0111	3.811	Q11_3	Standardized	0.6013
q11_comb	230	4.8978	1.4347	1127	1	7			
Variable: emotional									
Q12_1	230	5.2739	1.5438	1213	1	7	Q12_1	Raw	0.78606
Q12_2	230	4.887	1.6442	1124	1	7	Q12_2	Standardized	0.78701
Variable: communication									
Q13_3	225	5.1333	1.5641	1155	1	7	Q13_3	Raw	0.7974
Q13_4	225	5.3778	1.4713	1210	1	7	Q13_4	Standardized	0.80192
q13_comb	225	5.5511	1.1381	1249	1	7			
Variable: literacy									
Q14_1	222	2.4742	1.0211	549.27	0.0111	3.8111	Q14_1	Raw	0.83262
Q14_3	222	5.5541	1.2954	1233	1	7	Q14_3	Standardized	0.84969
q14_comb	222	3.4755	0.8239	771.56	0.3407	4.8741			
Variable: rights									
Q15_1	220	5.8546	1.2521	1288	1	7	Q15_1	Raw	0.75781
Q15_2	220	5.9546	1.0632	1310	2	7	Q15_2	Standardized	0.76116
q15_comb	220	5.4273	1.1243	1194	1.5	7			

N=number of observations

Table 4: Reliability Analysis using Cronbach Alpha (Author, 2023)

Table 4 above shows descriptive statistics and Cronbach coefficient alpha values for DQ variables identity, use, safety, security, emotional, communication, literacy, and rights. Q8_3 scored higher on the identity variable than Q8_1 and Q8_2. Q8_1, Q8_2, and Q8_3's raw Cronbach's alpha (0.676726) indicate moderate internal consistency. Standardized variables have higher Cronbach's alpha than raw variables. (0.753097). The use variable shows Q9_1, Q9_2, and q9_comb's Cronbach's Coefficient Alpha. Q9_1&2. Q9_1, Q9_2 and q9_comb's

raw Cronbach's alpha (0.740788) indicates good internal consistency. Standardized variables have higher internal consistency than raw variables, Cronbach's alpha. (0.774993).

Safety descriptive statistics show similar mean scores for both variables, indicating that respondents rated both questions similarly. 10_1 and Q10 2's raw Cronbach's alpha (0.746818) indicates internal consistency. Standardised variables have a high Cronbach's alpha. (0.747025). High internal consistency suggests the scale measures one construct well. Both variables have similar mean scores, indicating they measure similar constructs. The security variable shows Q11_1, Q11_3, and q11_comb's raw Cronbach's alpha (0.590993) indicates poor internal consistency. Standardised variables' internal consistency is slightly better than raw variables' (0.601298). Low internal consistency suggests the scale may not measure one construct well. Cronbach's alpha is 0.786060 for Q12_1 and Q12_2. Standardised variables have high internal consistency. (0.787007). High internal consistency suggests the scale measures one construct well.

The mean scores for Q13_3, Q13_4, and q13_comb are similar, indicating that respondents rated each communication variable similarly. Cronbach's alpha shows internal consistency (0.797403). The questions appear to measure similar constructs with a standardised Cronbach's alpha of 0.801919. Q14_1, Q14_3, and q14_comb literacy descriptive statistics. Q14_1 and Q14_3 show respondents' digital literacy, ranging from 0 to 4. (High digital literacy). Respondents scored moderately literate at 2.47417. The literacy frequency scale has good internal consistency, with raw and standardised Cronbach coefficient values. (0.832616 and 0.849692). The three digital rights variables' raw scores' coefficient alpha (0.757807) indicates good internal consistency. Alpha was slightly higher for z-scores. (0.761156). The items were internally consistent and comparable to a standard set.

4.5.1 *Summary of reliability analysis*

The alphas were greater than 0.7 except for digital security. Combining items with poor coefficients to give 9_comb, 11_comb, 13_comb, 14_comb, and 15_comb improved the overall coefficient of the DQ variable. Thus, the constructs were mostly consistent and reliable > 0.7 except for the digital security variable. Further analysis using regression modelling, was used to provide more insights into the relationships between the DQ variables and their predictors.

4.6 Validity of measurement scale

Confirmatory factor analysis (CFA) was used to examine the validity and reliability of the scale and to test for validity. **Table 5** below represents the output of the CALIS procedure. Several fit indices were included in the output to evaluate the model's data fit.

The CALIS Procedure
Mean and Covariance Structures: Full Information Maximum Likelihood Estimation

Fit Summary		
Absolute Index	Chi-Square	321.4392
	Chi-Square DF	194
	Pr > Chi-Square	<.0001
	Standardized RMR (SRMR)	0.0641
Parsimony Index	RMSEA Estimate	0.0534
	RMSEA Lower 90% Confidence Limit	0.0429
	RMSEA Upper 90% Confidence Limit	0.0636
	Akaike Information Criterion	15908.6006
	Bozdogan CAIC	16272.5231
	Schwarz Bayesian Criterion	16190.5231
Incremental Index	Bentler Comparative Fit Index	0.9350
	Bentler-Bonett Non-normed Index	0.9152

NOTE: Saturated mean structure parameters are excluded from the computations of fit indices.

Table 5: Data Fit Analysis (Author, 2023)

With a chi-square value of 321.4392 and a p-value less than 0.0001, this index indicates that the model shows a poor fit. Smith and McMillan (2001), note that chi-square alone may not have sufficient power with smaller sample sizes. The results of the chi-square test must therefore be taken in the context of the sample

profile of the study, specifically the small sample size of non-gamers discussed in **Chapter 5**. The standardised root mean square residual (SRMR) is 0.0641, which is less than 0.08, indicating an ok fit for this index.

The parsimony index, which consists of RMSEA, is also used to measure model fit. The 90% confidence limits for the RMSEA are 0.0429 and 0.0636. The incremental index consists of Bentler's CFI and Bentler-Bonett Non-normed Index (NNFI) indices quantify the improvement in model fit over baseline models. Bentler CFI and Bentler-Bonett NNFI are 0.9350 and 0.9152, respectively, indicating excellent to very good model fit, (Bentler & Bonnet, 1980).

Despite the chi-square test and SRMR indicating poor fit, the RMSEA, SRMR, Bentler's CFI, and NNFI indicate a good fit. Considering the limitations of the chi-squared index, the model fit was determined to be satisfactory.

Table 6 below shows the standardized results for PATH List in the CFA. The variables were reduced by combining weaker variables that measure the same construct to improve overall model fit, (Malang-Indonesia, 2014).

Standardized Results for PATH List

Variable			Estimate	Standard Error	t Value	Pr > |t|
identity	===>	Q8_1	0.85093	0.04181	20.3537	<.0001***
identity	===>	Q8_2	0.91156	0.04207	21.6654	<.0001***
identity	===>	Q8_3	0.42347	0.05868	7.2165	<.0001***
use	===>	Q9_1	0.72225	0.04357	16.5777	<.0001***
use	===>	Q9_2	0.78735	0.04075	19.3208	<.0001***
use	===>	q9_comb	0.69302	0.04767	14.5382	<.0001***
safety	===>	Q10_1	0.84967	0.05859	14.5027	<.0001***
safety	===>	Q10_2	0.70161	0.05679	12.3534	<.0001***
security	===>	Q11_1	0.62291	0.06507	9.573	<.0001***
security	===>	q11_comb	0.65567	0.05634	11.6368	<.0001***
security	===>	Q11_3	0.43511	0.0688	6.3243	<.0001***
emotional	===>	Q12_1	0.69499	0.04514	15.3978	<.0001***
emotional	===>	Q12_2	0.93356	0.04064	22.9699	<.0001***
communica	===>	q13_comb	0.68109	0.04298	15.8468	<.0001***
communica	===>	Q13_3	0.80773	0.03266	24.7352	<.0001***
communica	===>	Q13_4	0.80461	0.03275	24.5699	<.0001***
literacy	===>	Q14_1	0.73565	0.03703	19.8647	<.0001***
literacy	===>	q14_comb	0.83585	0.02982	28.0269	<.0001***
literacy	===>	Q14_3	0.86235	0.02775	31.0787	<.0001***
rights	===>	Q15_1	0.70617	0.04795	14.726	<.0001***
rights	===>	Q15_2	0.74319	0.04632	16.0448	<.0001***
rights	===>	q15_comb	0.71311	0.04928	14.4709	<.0001***

****=p<.0001*

Table 6: Survey Confirmatory Factor Analysis (Author, 2023)

The results show that all variables have a statistically significant effect on the dependent variable, which is the overall digital intelligence score. The highest parameter estimates were observed for Q8_2 (standardized coefficient=0.91) and Q14_3 (standardized coefficient=0.86), while the lowest estimate was observed for Q8_3 (standardized coefficient=0.42). These results suggest that identity and literacy are the most important predictors of digital intelligence, while safety and security have a relatively weaker impact. However, it is important to note that all variables have a significant effect, and the coefficients can provide valuable insights into the relative importance of each predictor in the model.

4.6.1 *Error Covariances*

Table 7 below displays the error covariances. The result indicates the presence of significant LM statistics. The highest LM (18.2401) is associated with the error pair Q11_3 and Q11_1 which is also the most statistically significant (chi-sq =<.001). The remaining paired variables are all statistically significant except for the pairings q13_comb and q11_comb (chi-sq = 0.0114), and q9_2 and q11_comb (chi-sq=0.0158). The presence of significant LM statistics for the error covariances suggests that there are unaccounted exogenous factors affecting the variables in the model.

Rank Order of the 10 Largest LM Stat for Error Variances and Covar

Error Of	Error Of	LM Stat	Pr > ChiSq	Parm
Q11_3	Q11_1	18.2401	<.0001	0.304
Q9_2	Q9_1	10.87556	0.001	0.452
q15_comb	Q10_2	10.28155	0.0013	0.266
Q15_2	q14_comb	9.92284	0.0016	0.095
Q13_3	Q12_1	9.69852	0.0018	-0.271
q11_comb	Q11_3	8.7991	0.003	-0.234
Q8_1	Q14_3	8.04734	0.0046	-0.112
Q9_1	Q11_1	7.3591	0.0067	-0.162
q13_comb	q11_comb	6.40404	0.0114	-0.179
Q9_2	q11_comb	5.82186	0.0158	0.279

Table 7: Modification Indices Error Covariances (Author, 2023)

4.7 Correlation Analysis

4.7.1 *Correlations Testing*

The Pearson correlation coefficient shown in **Table 8** below was used to measure the linear association between the independent variables of gaming experience, duration, and intensity.

Pearson Correlation Coefficients

	Pearson Correlation	experience	duration	intensity
experience	Pearson Correlation	1	0.3802	0.3025
	Sig. (2-tailed)		<.0001	<.0001
	N	212	212	212
duration	Pearson Correlation	0.3802	1	0.72143
	Sig. (2-tailed)	<.0001		<.0001
	N	212	230	212
intensity	Pearson Correlation	0.3025	0.72143	1
	Sig. (2-tailed)	<.0001	<.0001	
	N	212	212	212

Prob > |r| under H0: Rho=0
N= Number of Observations

Table 8: Correlation Analysis (Author, 2023)

The correlation coefficients between the three variables were found to be moderate to weak, with gaming experience and gaming duration showing a weak positive correlation (r=0.3802). Gaming experience and gaming intensity, as well as gaming duration and gaming intensity, had weak to moderate positive correlations (r=0.3025 and r=0.72143).

4.8 Regression Analysis

4.8.1 *Means Analysis*

Table 9 below shows means statistics for non-gamers and gamers. Based on the means for each group, it appears that gamers tend to score lower on the identity, safety, security, emotional, communication, and rights variables compared to non-gamers. However, these differences are not statistically significant as shown in the following table below except for the identity variable.

Non-gamers show a higher mean (0.44) than gamers (-0.03). This suggests that gamers are less likely to use their real identities when using digital platforms or media.

Descriptive Statistics

Variable: identity	N	Mean	Std Dev	Std Err	Minimum	Maximum
non-gamers	17	0.4435	0.7885	0.1912	-1.5154	1.1695
gamers	203	-0.0371	0.9506	0.0667	-1.6705	1.2025
Variable: safety						
non-gamers	17	-0.1964	0.9181	0.2227	-1.9168	0.8232
gamers	203	0.0164	0.8381	0.0588	-2.4118	0.9695
Variable: security						
non-gamers	17	-0.0696	0.7831	0.1899	-1.9749	0.9123
gamers	203	0.00583	0.7792	0.0547	-3.0172	1.5639
Variable: emotional						
non-gamers	17	0.1817	0.8962	0.2174	-2.1811	1.3442
gamers	203	-0.0152	0.9487	0.0666	-2.6507	1.3962
Variable: communication						
non-gamers	17	-0.0897	1.0676	0.2589	-2.567	1.2925
gamers	203	0.00751	0.9124	0.064	-3.6133	1.5067
Variable: digital use						
non-gamers	17	-0.2485	0.853	0.2069	-2.0453	1.202
gamers	203	0.0208	0.8949	0.0628	-2.1664	1.6407
Variable: literacy						
non-gamers	17	-0.2024	1.0966	0.266	-2.5929	1.4788
gamers	203	0.0169	0.9198	0.0646	-3.7125	1.5525
Variable: rights						
non-gamers	17	0.1728	0.5673	0.1376	-0.6733	1.1165
gamers	203	-0.0145	0.8872	0.0623	-3.8058	1.3608

N=number of observations

Table 9: Gaming Experience Descriptive statistics (Author, 2023)

Finally, it is worth noting that the standard errors are generally smaller for the gamers group. This may be because of the larger sample size for gamers (*N=203*) compared to the non-gamers(*N=17*).

4.9 Analysis of Hypothesis (H1), (H2) and (H3)

4.9.1 *Hierarchical Linear Regression Modelling*

Hierarchical regression models were used to statistically analyse the relationship between predictor variables and dependent variables. Statistical models of the variable sets that best predict the dependent DQ variable were created based on the findings of this study. In each of the sections below, the linear models build on the previous model by adding additional variables, resulting in a sequence of models with increasing complexity starting with the demographic variables. Variables that add little to no value in predicting the dependent variable are excluded from the variable set, (Lee, 2016). In some cases, the models have variables that were included in preceding models removed to reduce model complexity if it is determined that their contribution to the model is not substantial, (Kumar, & Singh, 2019). Bozdogan CAIC, Schwarz Bayesian Criterion (SBC), and R^2 measures were employed to compare the models. The best model to predict the dependent DQ variable is then selected.

a. ***Identity***

Table 10 below shows seven models for predicting the identity variable. The first model has the lowest AIC, CAIC, and SBC. However, Model 1 only has two control variables (age, children). Model 2 and Model 7 have almost similar AIC, CAIC, and SBC coefficients that are lower than the remaining models, three, four, five, and six. The two models also use more variables compared to Model 1. When the variable children is removed from Model 7, the variance explained by the model increases ($R^2 = 0.2336$).

Model 7's variance ($R^2 = 0.2336$) is higher than the variance of model 2 ($R^2 = 0.2137$) making it more suited to measuring the dependent variable of identity. In Model 7, of the three gaming constructs only gaming experience (p-value = 0.0066) is shown as influencing digital identity. Gaming duration and intensity are not shown included in the model set as predictors of digital identity.

Variable: identity

Parameter	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	β	P	B	P	β	P	β	P	β	P	β	P	β	P
age	-0.1658	0.0273**	0.06848	0.0204**	0.06861	0.0197**	0.06767	0.015**	-0.1548	0.0292**	-0.1677	0.0134**	-0.14332	0.0166**
children	0.14918	0.0474**	0.06929	0.2403	0.06925	0.249	0.06877	0.3846	0.06328	0.3813	0.06084	0.3776	-	-
security			0.10591	0.0461**	0.10564	0.0512*	0.10403	0.061**	0.2303	0.0343**	0.20337	0.0522**	0.2154	0.0388**
emotional			0.09214	<.0001***	0.09253	<.0001***	0.09163	<.0001***	0.47517	<.0001***	0.49024	<.0001***	0.50477	<.0001***
communication			0.12973	<.0001***	0.12998	<.0001***	0.12971	<.0001***	-0.5831	<.0001***	-0.6273	<.0001***	-0.64422	<.0001***
literacy			0.09998	0.005**	0.1012	0.004**	0.10006	0.0046**	0.23937	0.0222**	0.29037	0.0034**	0.29144	0.0035**
experience					0.06151	0.4998	0.0707	0.4698	0.07529	0.2732	-	-	-0.16227	0.0066**
duration							0.07	0.0087	-0.1815	0.0624*	-0.1547	0.0103**		
intensity									0.05548	0.5576				
R2	0.0263		0.2137		0.2135		0.2348		0.2257		0.2307		0.2336†	
AIC	18		70		88		108		130		88		70†	
CAIC	57.5016		223.618		281.119		345.01		410.037		281.119		223.6175†	
SBC	48.5016		188.618		237.119		291.01		345.037		237.119		188.6175†	

*Notes for parameters: β= standardized parameters, P= p value, ***=p<.01, **=p<.05, *p=p<.10 .*
Notes for Information criteria: AIC = Akaike's, CAIC=Bozdogan CAIC, SBC=Schwarz Bayesian Criterion, †=model best(lowest) score.
Number of observations (N) = 220.

Table 10: Predictor factors influencing digital identity (Author, 2023)

b. ***Use***

The results shown in **Table 11** below show that security, communication, literacy, and rights variables are significant predictors of digital use in all models. The safety variable is also significant in the first three models. The duration variable is significant in the third and fourth models, while the experience variable is significant only in the second model.

Based on the statistical analysis of the hierarchical models for use, model 4 (R^2 = 0.6439) is the best fit. Duration is the only gaming variable with a moderately significant relationship (p-value = 0.0754) with the use variable. Security (p-value = <0.0001), safety (p-value = 0.0041), communication (p-value = 0.0003), literacy (p-value = <0.0001), and rights (p-value = <0.0001) are significant predictors of use. Statistical analysis indicates that gaming duration is the only variable with a moderately significant relationship use. Therefore, there is no evidence to support the hypothesis being tested from the variable use.

Variable: use

Parameter	Model 1		Model 2		Model 3		Model 4	
	β	P	β	P	β	P	β	P
security	0.56134	<.0001***	0.55492	<.0001***	0.54988	<.0001***	0.56539	<.0001***
safety	0.15061	0.0059**	0.15069	0.006**	0.14799	0.0066**	0.15838	0.0041**
communicatior	0.37699	<.0001***	0.37909	<.0001***	0.35975	<.0001***	0.32832	0.0003**
literacy	-0.60961	<.0001***	-0.61695	<.0001***	-0.60722	<.0001***	-0.5947	<.0001***
rights	0.24964	<.0001***	0.26172	<.0001***	0.27673	<.0001***	0.28518	<.0001***
experience			0.04082	0.3414	-0.00832	0.867	-0.0301	0.5227
duration					0.09622	0.0499**	0.11743	0.0754**
intensity							-0.06459	0.3105
R2	0.6267		0.6248		0.63		0.6439†	
AIC	54		70		88		108†	
CAIC	172.6279		223.777		281.32		340.9131†	
SBC	145.6279		188.777		237.32		286.9131†	

*Notes for parameters: β= standardized parameters, P= p value, ***=p<.01, **=p<.05, *p=p<.10 .*
Notes for Information criteria: AIC = Akaike's, CAIC=Bozdogan CAIC, SBC=Schwarz Bayesian Criterion, †=model best(lowest) score.
Number of observations (N) = 220.

Table 11: Predictor factors influencing digital use (Author, 2023)

c. ***Safety***

The best model for the safety variable is shown to be Model 3 as shown in **Table 12** below, as it has the highest variance (R^2 = 0.5784) among the five models. Gaming experience (p-value = 0.0974) is the only gaming variable that shows a weak relationship with the DQ digital safety variable.

Use (p-value = 0.0077), security (p-value = <0.0001), emotional (p-value = <0.0001), communication (p-value = <0.0001), literacy (p-value = 0.0388), rights (p-value = <0.0001) and experience (p-value = <0.0974) are also shown to be predictors in the model.

Statistical analysis indicates gaming experience is the only DQ variable that shows a weak relationship digital safety. Therefore, does not support the hypothesis being tested.

Variable: safety

Parameter	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	β	B	β	B	β	B	β	B	β
black	-0.15012	0.023**	-0.06943	0.126	-0.07448	0.0983*	-0.07398	0.1011	0.04786	0.149
use			0.17894	0.012**	0.18802	0.0077**	0.18647	0.0085**	0.07606	0.0067**
security			1.18219	<.0001***	1.18746	<.0001***	1.18756	<.0001***	0.10285	<.0001***
emotional			-0.53724	<.0001***	-0.55183	<.0001***	-0.54993	<.0001***	0.07506	<.0001***
communication			-0.42083	<.0001***	-0.43173	<.0001***	-0.43161	<.0001***	0.10071	<.0001***
literacy			0.1468	0.0871**	0.17773	0.0388**	0.17838	0.0379**	0.08924	0.015**
rights			-0.32599	<.0001***	-0.34977	<.0001***	-0.34491	<.0001***	0.06493	<.0001***
experience					-0.07607	0.0974**	-0.06521	0.2193	0.05187	0.2254
duration							-0.01661	0.7526	0.07281	0.7153
intensity									0.07029	0.8344
R2	0.0225		0.5711		0.578†		0.5784		0.5697	
AIC	10		88		108†		130		154	
CAIC	31.9681		281.3196		345.2559†		415.5858		486.1169	
SBC	26.9681		237.3196		291.2559†		350.5858		409.1169	
N	220		220		220†		220		220	

*Notes for parameters: B = unstandardized parameters, β = standardized parameters, *** = p < .01, ** = p < .05, * = p < .10.*
Notes for information criteria: AIC = Akaike's, BIC = Bayesian, SBC = Schwarz Bayesian, PC = Prediction. † = model with best (lowest) score.

Table 12: Predictor factors influencing digital use (Author, 2023)

d. ***Emotional***

Table 13 below presents five hierarchical regression models. Based on the R-squared values, the best model for the emotional variable is Model 4 (R^2 = 0.7201). Only the gaming experience variable (p-value = 0.0707) is shown to be a predictor of digital emotional intelligence with a moderate influence on this variable. Duration and intensity do not predict digital emotional intelligence according to the model.

Model 4 includes the variables of children (p-value = 0.1941), identity (p-value = 0.0001), security (p-value = <0.0001), safety (p-value = <0.0001), communication (p-value = <0.0001), literacy (p-value = <0.0001), rights (p-value = <0.0145), and experience (p-value = 0.0707) as predictors of digital emotional intelligence.

Statistical analysis indicates no gaming variable has a significant relationship with the emotional variable. The hypothesis being tested are not supported by this variable.

Variable: emotional

Parameter	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	P	β	P	β	P	β	P	β	P
children	0.11141	0.0958**	0.04931	0.1808	0.04521	0.2175	0.04791	0.1941	0.04271	0.2746
identity			0.15541	<.0001***	0.14949	0.0002**	0.15427	0.0001**	0.15144	0.0003**
security			0.71948	<.0001***	0.73547	<.0001***	0.72909	<.0001***	0.73636	<.0001***
safety			-0.34318	<.0001***	-0.34758	<.0001***	-0.34684	<.0001***	-0.34845	<.0001***
communication			0.45048	<.0001***	0.42723	<.0001***	0.42558	<.0001***	0.39068	<.0001***
literacy			-0.27791	<.0001***	-0.25453	<.0001***	-0.25377	<.0001***	-0.22772	0.0004**
rights			-0.11614	0.0203**	-0.13146	0.0094**	-0.12348	0.0145**	-0.12639	0.018**
experience					-0.06159	0.1006	-0.0782	0.0707**	-0.06728	0.1144
duration							0.03712	0.3944	0.06162	0.304
intensity									-0.0269	0.6392
R2	0.0124		0.7152		0.7183		0.7201†		0.7094	
AIC	10		88		108		130†		154	
CAIC	31.9454		281.1192		345.0099		415.2897†		485.7366	
SBC	26.9454		237.1192		291.0099		350.2897†		408.7366	

*Notes for parameters: β= standardized parameters, P= p value, ***=p<.01, **=p<.05, *p=p<.10 .*
Notes for Information criteria: AIC = Akaike's, CAIC=Bozdogan CAIC, SBC=Schwarz Bayesian Criterion, †=model best(lowest) score.
Number of observations (N) = 220.

Table 13: Predictor factors influencing digital emotional intelligence (Author, 2023)

e. ***Security***

Based on the R2 values in **Table 14** below, the best model for the variable emotional seems to be Model 7 (R2 = 0.8856), as it has the highest R2. Additionally, it has the lowest AIC (88) and CAIC (281.3196) values compared to other models. In this model, none of the gaming variables is shown to predict digital security.

Model 7 shows use (p-value = <0.0001), safety (p-value = <0.0001), emotional (p-value = <0.0001), identity (p-value = 0.0031), communication (p-value = <0.0001), literacy (p-value = 0.0045) and rights (p-value = <0.0001) predicting the emotional variable.

Statistical analysis indicates no gaming variable has a significant relationship with the security variable. The hypothesis being tested are not supported by this variable.

variable: security

Parameter	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	β	P	β	P	β	P	β	P	β	P	β	P	β	P
age	-0.1335	0.0776*	-0.02128	0.4306	-0.01637	0.544	-0.01616	0.5509	-0.01297	0.6499	-	-	-	-
children	0.17976	0.0168**	0.0142	0.6021	0.01277	0.6379	0.0129	0.6355	0.01552	0.5916	-	-	-	-
use			0.1614	<.0001***	0.15416	<.0001***	0.15343	<.0001***	0.16448	<.0001***	0.16812	<.0001***	0.16715	<.0001***
safety			0.3242	<.0001***	0.32626	<.0001***	0.32862	<.0001***	0.31748	<.0001***	0.31691	<.0001***	0.32275	<.0001***
emotional			0.2842	<.0001***	0.29059	<.0001***	0.2904	<.0001***	0.29256	<.0001***	0.2885	<.0001***	0.27919	<.0001***
identity			0.06844	0.009**	0.07012	0.0072**	0.06946	0.009**	0.06974	0.0125**	0.0753	0.006**	0.07613	0.0031**
communication			0.25779	<.0001***	0.26474	<.0001***	0.26927	<.0001***	0.26707	<.0001***	0.26253	<.0001***	0.25336	<.0001***
literacy			0.12618	0.0052**	0.10837	0.0183**	0.10378	0.0242**	0.10612	0.0285**	0.10443	0.0283	0.12702	0.0045**
rights			0.18356	<.0001***	0.19495	<.0001***	0.19346	<.0001***	0.18885	<.0001***	0.19196	<.0001***	0.18568	<.0001***
experience					0.04146	0.0867*	0.04244	0.1276	0.0402	0.141**	0.03991	0.1406		
duration							-0.00253	0.9288	-0.02426	0.532*	-0.02039	0.5951		
intensity									0.02934	0.4279	0.02592	0.4777		
R2	0.0271		0.8836		0.8846		0.8844		0.8812		0.8833		0.8856†	
AIC	18		130		154		180		208		154		88†	
CAIC	57.5016		415.2897		491.959		575.017		656.06		486.117		281.3196†	
SBC	48.5016		350.2897		414.959		485.017		552.06		409.117		237.3196†	

*Notes for parameters: β= standardized parameters, P= p value, ***=p<.01, **=p<.05, *p=p<.10 .*
Notes for Information criteria: AIC = Akaike's, CAIC=Bozdogan CAIC, SBC=Schwarz Bayesian Criterion, †=model best(lowest) score.
Number of observations (N) = 220.

Table 14 : Predictor factors influencing digital security (Author, 2023)

f. ***Communication***

Based on the models and their respective parameters in **Table 15** below, Model 6 would be the best model for predicting the communication variable. Model 6 has a higher variation (R2 = 0.8352) for communication compared to Models 1, 2, and 5, which indicates that it has the strongest relationship with the dependent variable. Although Models 3 and 4 have higher R2 variations (R2 = 0.8361 and R2= 0.8368), Model 6 has the lower AIC (108) and CAIC (345.2559), indicating that it is the less complex model among the seven models.

None of the gaming variables of experience, duration, and intensity are shown to be predictors of digital communication with all three variables not adding value to the model.

Statistical analysis indicates no gaming variable has a significant relationship with the communication variable. The hypothesis being tested are not supported by this variable.

Variable: communication

Parameter	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	B	β	B	β	B	β	B	β	B	β	B	β
female	-0.078	0.2458	-0.023	0.4226	-0.031	0.2773	-0.033	0.2591	-0.02702	0.3775	-	-
identity			-0.144	<.0001***	-0.143	<.0001***	-0.144	<.0001***	-0.13971	<.0001***	-0.14619	<.0001***
use			0.1471	0.0009**	0.1464	0.0009**	0.1449	0.0011**	0.15108	0.0017	0.15269	<.0001***
safety			-0.178	<.0001***	-0.182	<.0001***	-0.181	<.0001***	-0.19452	<.0001***	-0.18712	<.0001***
emotional			0.259	<.0001***	0.2441	<.0001***	0.2456	<.0001***	0.22735	<.0001***	0.24291	<.0001***
security			0.3629	<.0001***	0.3761	<.0001***	0.3792	<.0001***	0.38583	<.0001***	0.37827	<.0001***
literacy			0.5096	<.0001***	0.5197	<.0001***	0.5193	<.0001***	0.5237	<.0001***	0.52407	<.0001***
rights			-0.117	0.0039**	-0.126	0.002**	-0.129	0.0016**	-0.12898	0.0033**	-0.13415	0.0009**
experience					-0.05	0.0882*	-0.046	0.1683	-0.04465	0.178	-0.04404	0.1258
duration							-0.009	0.7918	0.00854	0.8549		
intensity									-0.01518	0.732		
R2	0.0061		0.8346		0.8361		0.8368		0.8281		0.8352†	
AIC	10		108		130		154		180		108†	
CAIC	31.968		345.26		415.59		492.31		568.1885		345.2559†	
SBC	26.968		291.26		350.59		415.31		478.1885		291.2559†	

*Notes for parameters: β= standardized parameters, P= p value, ***=p<.01, **=p<.05, *p=p<.10 .*
Notes for Information criteria: AIC = Akaike's, CAIC=Bozdogan CAIC, SBC=Schwarz Bayesian Criterion, †=model best(lowest) score.
Number of observations (N) = 220.

Table 15: Predictor factors influencing digital communication (Author, 2023)

g. ***Literacy***

Model 2 has a similar R2 value of 0.7529 to model 3 by lower AIC (108) and CAIC (345.2559) than model 3 as shown in **Table 16** above. The lower AIC value suggests that model 2 has a better balance between the goodness of fit and the complexity of the model compared to model 3. Therefore, Model 2 appears to be the most appropriate model for predicting the literacy variable.

Gaming experience (p-value = 0.0862) is the only gaming variable shown to have a weak influence on the digital literacy variable. Gaming duration and intensity do not show a relationship with digital literacy. Other predictors of the literacy variable are shown as use (p-value = <0.0001), safety (p-value = 0.0354), emotional (p-value = 0.0011), identity (p-value = 0.034), security (p-value = <0.0167), communication (p-value = <0.0001), rights (p-value = <0.0001), and experience (p-value = <0.0048).

Statistical analysis indicates that the gaming experience variable is the only gaming variable that has weak relationship with the emotional variable. The hypothesis being tested are not supported by literacy variable.

Variable: literacy

Parameter	Model 1		Model 2		Model 3		Model 4	
	B	β	B	β	B	β	B	β
use	-0.39959	<.0001***	-0.39567	<.0001***	-0.39721	<.0001***	-0.41578	<.0001***
safety	0.09318	0.0718*	0.10783	0.0354**	0.11094	0.0307**	0.13633	0.0104**
emotional	-0.23774	0.0001**	-0.20384	0.0011**	-0.20535	0.001**	-0.17481	0.0069**
identity	0.0769	0.0458**	0.0804	0.034**	0.08928	0.0203**	0.08173	0.042**
security	0.28258	0.0043**	0.23616	0.0167**	0.22403	0.023**	0.22439	0.0278**
communication	0.79372	<.0001***	0.78579	<.0001***	0.7882	<.0001***	0.7627	<.0001***
rights	0.20277	<.0001***	0.22853	<.0001***	0.23742	<.0001***	0.24408	<.0001***
experience			0.09855	0.0048**	0.0775	0.0567*	0.06796	0.0862*
duration					0.04277	0.2955	0.00971	0.863
intensity							0.02914	0.586
R2	0.7455		0.7529†		0.7529		0.7493	
AIC	88		108†		130		154	
CAIC	281.3196		345.2559†		415.5858		486.1169	
SBC	237.3196		291.2559†		350.5858		409.1169	

*Notes for parameters: β= standardized parameters, P= p value, ***=p<.01, **=p<.05, *p=p<.10 .*
Notes for Information criteria: AIC = Akaike's, CAIC=Bozdogan CAIC, SBC=Schwarz Bayesian Criterion, †=model best(lowest) score.
Number of observations (N) = 220.

Table 16: Predictor factors influencing digital literacy (Author, 2023)

h. ***Rights***

Model 4 in **Table 17** below has the highest R^2 value = 0.5735 compared to Model 4 (R2 = 0.5668). However, Model 4 has better AIC (180) and CAIC (575.0165) than model 5 (AIC = 208 and CAIC = 656.0598). Therefore, Model 4 appears to be the most appropriate model for predicting the digital rights variable. In the model, digital experience (p-value = 0.0707) and duration (p-value = 0.06) are shown to be moderate predictors of digital rights. Intensity is not a predictor of digital rights in the model.

Table 17 also shows the predictors for the rights variable to include children (p-value = 0.0466), postgrad use (p-value = 0.103), safety (p-value = <0.0001), emotional (p-value = 0.0062), identity (p-value = 0.1081), security (p-value = <0.0001), communication (p-value = 0.0012), literacy (p-value = <0.0001).

Statistical analysis indicates that no gaming variable has a significant relationship with the rights variable. The hypothesis being tested are not supported by this rights variable.

Variable: rights

Parameter	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	β	B	β	B	β	B	β	B	β
children	0.15783	0.0164	0.11159	0.0169**	0.10177	0.026**	0.09142	0.0466**	0.09233	0.052*
postgrad	0.10146	0.1256	0.06681	0.1495	0.0658	0.1463	0.07366	0.103	0.08034	0.0886*
use			0.34228	<.0001***	0.34172	<.0001***	0.35801	<.0001***	0.38661	<.0001***
safety			-0.37303	<.0001***	-0.3798	<.0001***	-0.37411	<.0001***	-0.37938	<.0001***
emotional			-0.21797	0.0106**	-0.2453	0.0033**	-0.22874	0.0062**	-0.22561	0.0079**
identity			-0.05753	0.2653	-0.0658	0.1919	-0.08167	0.1081	-0.09245	0.076**
security			0.73997	<.0001***	0.7571	<.0001***	0.7373	<.0001***	0.69395	<.0001***
communication			-0.32832	0.0029**	-0.3433	0.0015**	-0.34815	0.0012**	-0.32298	0.0029**
literacy			0.37479	<.0001***	0.4064	<.0001***	0.41626	<.0001***	0.41096	<.0001***
experience					-0.1526	0.0009**	-0.09714	0.0707*	-0.07938	0.1239
duration							-0.10248	0.06*	-0.10051	0.1709
intensity									0.01184	0.8655
R2	0.037		0.5403		0.5615		0.5668†		0.5735	
AIC	18		130		154		180†		208	
CAIC	57.5016		415.2897		491.959		575.0165†		656.0598	
SBC	48.5016		350.2897		414.959		485.0165†		552.0598	

*Notes for parameters: β= standardized parameters, P= p value, ***=p<.01, **=p<.05, *p=p<.10 .*
Notes for Information criteria: AIC = Akaike's, CAIC=Bozdogan CAIC, SBC=Schwarz Bayesian Criterion, †=model best(lowest) score.
Number of observations (N) = 220.

Table 17: Predictor factors influencing digital rights (Author, 2023)

4.10 Statistical Analysis of Hypothesis (H4)

4.11 Moderator Analysis

Moderation analysis was conducted to test the moderations using the Baron and Kenny method, (Baron & Kenny, 1986). The demographic factors of age, race, having children, post-grad and undergrad qualifications, employment status, and working with computers were used in the analysis. Of the 21 moderation tests conducted to analyse if demographic factors exert an effect on the outcome in the case being the eight DQ variables, none of the demographic factors were found to moderate any of the DQ variables, (Baron & Kenny, 1986). Therefore, according to the results of this study demographic factors did not moderate the relationship between gaming and DQ.

4.12 Summary of the results/findings

No	Statistical Result	p value	Hypothesis Result
H1	Only One out of eight relationships was statistically significant.	Identity = 0.0277	Not Supported. Hypothesis is rejected
H2	Only Two out of eight linear regression models had gaming duration as a moderate to weak predictor of DQ variables.	Rights = 0.06 Use = 0.0754	Not Supported. Hypothesis is rejected
H3	Gaming intensity did not predict any of the DQ variables in the linear regression models.	-	Not Supported. Hypothesis is rejected
H4	Demographics did not moderate any of the relationships between gaming and DQ. No statistically significant moderations were found.	-	Not Supported. Hypothesis is rejected

Table 18: Summary of Hypotheses (Author, 2023)

Table 18 shows a summary of the results pertaining to the hypotheses made by the study.

CHAPTER 5. DISCUSSION OF THE RESULTS OR FINDINGS

5.1 Introduction

This study aimed to conduct a quantitative study into the influence of gaming on digital intelligence in South African organisations. The study achieved its aim by assessing the relationship between gaming and DQ in a sample of the South African workforce. This chapter discusses and explains the results of the study as outlined in **Chapter 4**. The study begins by outlining and discussing the sample profile before discussing the results pertaining to the influence of gaming on DQ. The moderating effects of demographics on the relationship between gaming and DQ are then discussed followed by a discussion of the DQ quotient and the conclusion.

5.2 Sample profile

A total of 230 responses were used in the statistical analysis of the study. As shown in **Table 19** below, 18 participants (7.83%) responded that they had not played videos in the past. Whilst 212 participants (92.17%) indicated that they had played video games previously. The sample size was therefore largely made up of participants who are gamers. A more biased rather than random sampling method may have been better suited to achieving a more representative sample of gamers and non-gamers. This sampling method may have assisted in overcoming challenges with the strength of the chi-square results (p=<0.0001) outlined in **section 4.5** of **Chapter 4**.

The FREQ Procedure

Q2	*Frequency*	*Percent*
No	18	7.83
Yes	212	92.17

Table 19: Population Sample Frequency Table (Author, 2023)

Table 1 in Section 4 shows that the number of missing values (N Miss) progressively increased as the questionnaire progressed. This may indicate that participants were more reluctant to continue with the DQ assessment due to its length. Combining the variables measuring the same constructs in the DQ assessments as outlined in **section 4.5** of **Chapter 4** may assist in strengthening the assessment whilst shortening it. The results and the discussion that follows should therefore be taken in the context of the sample's composition.

5.3 Discussion pertaining to hypothesis 1: The influence of gaming experience DQ

Gaming experience, duration, and intensity were hypothesised to predict DQ in South African workers. The study found little to no evidence to support this hypothesis. This study considered the paradigm that digital intelligence is multidimensional and may be learned and enhanced through some form of development and learning, (Demirel, Muhammet, & Olmez, 2012; Wiśniewska-Paź, 2018). The only evidence that could be found of gaming influencing DQ in the study's participants was in the relationship between gaming experience and digital identity. Regression analysis showed that gaming experience was the only independent variable with a statistically significant relationship with identity, while safety and security had weaker relationships.

Tests performed on the DQ variables, and the gaming experience variable identified the identity variable as the only moderately statistically significant variable ((Pr > |t| = 0.0277 and t value = 2.37). The error covariances of Q8_1 and Q14_3 was moderately statistically significant (chi-sq=0.0046) when examining modification indices. This suggested that exogenous factors may be affecting Q8_1, which is an identity variable. Regression analysis of the gaming experience and digital identity variables showed that non-gamers (mean = 0.4435) scored higher than gamers (mean = -0.0371), suggesting that gamers are less likely to use their real identities on digital platforms and media as they get older. Regressions of demographic variables against the identity variable supported age parameter estimates (Pr > |t| = 0.0181, t value = -2.3641).

Hierarchical linear regression modelling put forward models with the variables that may be best suited to predicting each of the DQ variables. In the models that were selected as predictors of the DQ variables in **Chapter 4**, gaming variables were found to have very little to no influence in predicting the DQ variables.

The findings outlined above were in line with expectations and theories arguing that the cognitive processes may not be the only predictors of DQ, and that other factors such as affective and social factors may also play a role, (Lutz & Huitt, 2018). One of the paradigms that have been offered to explain the relationship between digital environments and individuals is known as computers as social actors (CASA), (Nass and Moon, 2002). This paradigm considers the interaction between an individual and digital media as a social interaction, (Nass and Moon, 2002; Lee and Nass, 2003). Mayer (2001) supports this paradigm stating that social cues in digital media create the perception of a social presence and activate a social response scheme of the individual. The Cognitive-Affective-Social Theory of Learning in Digital Environments (CASTLE) is an extension of the CASA theory suggesting that affective factors such as motivation, interest, emotions, and social factors related to digital technologies, may play a larger role in developing digital intelligence than video gaming (Schneide, Beege, Nebel, Schuabert, and Rey, 2021). This paradigm by Schneide, Beege, Nebel, Schuabert, and Rey (2021) is supported by the study's findings in **Section 4.6**. of **Chapter 4** where the error covariances of several DQ variables appeared to have exogenous causes that were not part of this study. Identifying and incorporating such exogenous factors into the DQ model may potentially improve the model's performance and provide a more accurate measure of the relationships between gaming and DQ.

Other factors such as an individual's motivation and interest in digital technologies are some of the exogenous factors that could be included in the DQ model to develop and improve an individual's digital intelligence, (Hargittai and Hinnant, 2008). Cultural factors such as values and beliefs as well as social support can influence how individuals' approach and use digital technologies, (Hofstede et al., 2010; Charness & Boot, 2009). This study concludes that other

exogenous factors may exert a greater influence on DQ than gaming. Therefore, exogenous factors may have influenced this study's examination of the influence of gaming on DQ.

5.4 Discussion pertaining to hypothesis 2 and 3: The influence of gaming duration and intensity on DQ

The Pearson correlation coefficients between the three variables of gaming experience, gaming duration, and gaming intensity were found to have a weak positive correlation (r=0.3802, r=0.3025, and r=72143). These results seem to indicate that gaming duration and gaming intensity do not significantly contribute to the relationship between gaming and DQ. Further to this assertion, the study found that gaming experience was a predictor of five out of the eight DQ elements in the multi-linear regression models i.e., identity, use, safety, emotional, literacy, and rights. This contrasts with gaming duration which was found to be a predictor of just one variable and intensity was a predictor of none of the variables. Therefore, although none of the gaming variables showed significant relationships with DQ, it can be concluded based on the results that gaming experience was shown to be a slightly better predictor of elements of DQ, and that gaming duration and experience were not predictors of DQ.

The results of this study with regards to gaming duration are in line with the moderation analysis results of a study by Yu and Chan (2021), who found no statistically significant influence of video game training duration on effect size. The findings of this study and those by Yu and Chan (2021), and Smith et al. (2020) are supported by several other studies that noted cognitive gains for participants who played video games for periods as short as 40 minutes to 1 hour, (Kulworatit 2021; Qiu et al. 2018; Grazia, & Zorzi 2014; Levi, Shettko, Battles, Schmidt, Fahie, Griffon, and Hendrickson 2019; Montani, De Grazia, & Zorzi 2014; Levi, Shettko, Battles, Schmidt, Fahie, Griffon, & Hendrickson 2019; Montani, De Grazia, and Zorzi 2014; and Yu and Chan 2021).

Contenting assertions and findings by Quiroga et al. (2019) and Denilson et al. (2019), found that the repeated play of different types of video games gave distinct positive performance and IQ. However, it must be noted that these and previous studies have focused on understanding the cause-and-effect relationship between gaming intensity and other constructs of outcomes such as IQ and not DQ. As a result, this study adopts the notion that gaming duration and intensity do not influence DQ in the participants in this study. The practical implication of this finding in the work environment suggests that organisations that may be considering using gaming to develop digital cognition may need to consider incorporating exogenous factors to strengthen the effectiveness of the training, (Mayer, 2020).

5.5 Discussion pertaining to hypothesis 4: The moderating effect of demographics

This study hypothesised that some individual demographic factors moderate the cause-and-effect relationship between gaming and DQ elements. For example, younger participants may have higher DQ due to their earlier exposure to video gaming than older participants. The study discovered no statistically significant moderations by demographic factors. The nature of video gaming may explain the lack of significant moderation effects. Video games are intended to be engaging and immersive, and they frequently require problem-solving, spatial reasoning, and other cognitive processes that are relevant to the development of digital intelligence, (Sharma et al., 2021). As a result, the potential benefits of video gaming on digital intelligence may be comparable across demographic groups.

Interestingly, some previous studies, such as the study by Moreno-Ger et al., (2020), found significant moderating effects of age and gender on this relationship, whereas others found no significant moderating effects, (Feng et al., 2018). These studies, however, did not provide a clear theoretical explanation for the findings. The disparities in the findings of the various studies suggest that

additional research using more sensitive research measures and design may aid in bringing to light smaller moderating effects that may exist.

5.6 Discussion pertaining to DQ Quotient

If DQ is the cognitive ability that enables individuals to adapt to and succeed in the digital era, then it could be argued that these assertions also apply to the workplace, since the workplace is a component of the digital era, (DQInstitute, 2017; IEEE, 2021; Mithas & Smith, 2017; Na-Nan, Natabang, & Wongsuwan, 2020; Phunaploy et al., 2021; Rahman, Amalia, & Aziz, 2021). If also the assertions by DQ institute (2022) and Wisniewski-Pa (2018) are accepted, that more knowledge about the development of digital competencies is required to meet the needs of the 21st century, it could be argued that the improvement of the DQ quotient with new knowledge and its adaptation to the workplace could further strengthen the DQ quotient as a fit-for-purpose measure of DQ.

As stated in previous sections, the DQ quotient in its current form may have certain drawbacks that may necessitate further modification to strengthen it as a measure, shorten it, and make it more suitable for measuring DQ in the workplace. It is put forward in **section 5.2** that the quotient could be improved by combining variables that measure the same constructs. This would also contribute to reducing the quotient's length. In addition, some of the variables in the quotient may be deemed inadequate or less reflective of contemporary standards. **Table 20** below outlines some of the proposed enhancements to the DQ quotient resulting from this study.

DQ construct	Current Question	Proposed Improvements
Digital Identity	I use my real name for setting social network profiles, (Na-Nan et al., 2020).	The question could be improved by referring to collaboration and networking tools found in the workplace such as MS Teams and Zoom, (Author, 2023).
	I use my own picture in my profile, (Na-Nan et al., 2020).	I use a profile picture of myself that is in line with my company culture and values for my work collaboration tools, (Author, 2023).

	I will offer explanations if people disagree with me on digital media, (Na-Nan et al., 2020).	I use social media platforms to promote your personal brand and engage with your professional network, (Author, 2023).
	I will cease to communicate with people whose behaviour is inappropriate for digital media, (Na-Nan et al., 2020).	I use social media platforms to promote your personal brand and engage with your professional network, (Author, 2023).
Digital Use	I do not surf or browse digital media during working hours, (Na-Nan et al., 2020).	I use digital media to manage my time and prioritize tasks when using digital technologies for work, (Author, 2023).
	I allocate time to use digital media, (Na-Nan et al., 2020).	I use digital media to collaborate with colleagues and clients on projects
	I do not use digital media during family time, (Na-Nan et al., 2020).	I limit the amount of time I spend surfing and browsing digital media during working hours, (Author, 2023).
Digital Safety	If someone asks for my personal information on digital media, I will avoid or stop the communication, (Na-Nan et al., 2020).	I educate your colleagues and clients on online safety and security best practices, (Author, 2023).
	I do not browse rude content and pornographic websites, (Na-Nan et al., 2020).	I ensure that your digital devices and networks are secure and protected from cyber-attacks, (Author, 2023)
Digital Security	I do not respond or communicate with people or suspicious things that threaten my digital media security, (Na-Nan et al., 2020).	I ensure that confidential information and sensitive data are protected and stored securely, (Author, 2023).
	I acknowledge the feelings of others when they post sad messages and I reply to cheer them up, (Na-Nan et al., 2020).	I manage conflicts and misunderstandings that arise in digital communication channels, (Author, 2023).
	I use digital media to show my feelings of worry about friends and acquaintances, (Na-Nan et al., 2020).	I use digital technologies to build and maintain professional relationships with colleagues and clients, (Author, 2023).
Digital Rights	I understand that items communicated in digital media are the responsibility of the society, (Na-Nan et al., 2020).	I comply with data privacy laws and regulations when using digital technologies for work (Author, 2023)

Table 20: Proposed Improvements to DQ Quotient

5.7 Conclusion

There was little to no statistically significant evidence that gaming influences DQ among South African workers. Exogenous factors may have a larger influence on DQ development than gaming. Moreover, no evidence was discovered to support the hypothesis that demographics moderate the relationship between gaming and DQ among South African employees. Specialised gaming integrating exogenous factors may have a greater impact on predicting DQ than generic or

commercial video games. The complex interaction of cognitive, affective, and social factors that influence digital intelligence may account for the absence of significant moderation effects in the current investigation of the relationship between gaming and digital intelligence. However, the sampling method employed may have hampered the current investigation. Future research examining the potential moderating effects of demographic variables on the relationship between video gaming and digital intelligence, should consider using purposive sampling methods to gain meaningful participation from both gamers and non-gamers..

CHAPTER 6. CONCLUSIONS & RECOMMENDATIONS

6.1 Introduction

This chapter of the study is made up of three main sections. The first is the conclusions section which integrates the findings about the hypotheses and summarizes the entire study. The second section is the recommendations section which puts forward recommendations derived from the findings of the study. The chapter then concludes by suggesting areas for future research which makes up the third section of the chapter.

6.2 Conclusions regarding research sub question i

The aim of this study was to determine if gaming influences the development of digital intelligence in South African organisations. To achieve this aim, two sub-questions were developed. The first sub-question examines the relationship between gaming and DQ among South African employees. The results of the study reveal a non-statistically significant correlation between gaming experience and only one aspect of DQ in South African employees. The results also indicate that the duration and intensity of play have no influence on DQ among South African workers. The study concludes from its findings that gaming has very little to no influence on DQ in South African workers and that other exogenous factors may have a stronger influence on DQ development.

This study set out to examine possible links between cognitive benefits resulting from gaming reported by previous researchers. The results indicate that understanding the influence of other external factors is necessary for a comprehensive examination of the relationship between DQ cognitive benefits resulting from gaming and other external factors. Then it may be possible to precisely plot the contribution of gaming to the development of DQ with the sum of these factors.

The demographic composition of the participants revealed that most South African workers who have access to a digital device are currently or have previously engaged in gaming. This indicates that gaming has permeated the lives of South African employees. Despite the findings of the study, gaming may still provide South African organisations with new specialised methods of digital cognitive development if research can be expanded to examine modelling, observations, motivation, social, cultural, and affective factors in workplace gaming.

6.3 Conclusions regarding research sub question ii

The second sub-question was aimed at analysing if demographic factors moderate any of the relationships between gaming and DQ elements. Moderation analysis revealed that no demographic factors moderate relationships between gaming and DQ. Regression ttests on demographic variables such as gender, age, and education, as well as employment-related variables such as employment status and computer-related work are displayed in **Table 9**. The parameter estimates for age ($Pr > |t| = 0.0181$, t value = -2.3641), which indicate that as age increases, identity decreases. The results showed that age ($Pr > |t| = 0.0181$) and having children ($Pr > |t| = 0.0448$) are significantly associated with identity, with negative and positive parameter estimates, respectively.

Demographic factors, therefore, had a nonsignificant influence on the relationship between gaming and DQ. However, the results from regression analysis seem to indicate that some demographic factors could be used to predict some behaviours in gamers in the workplace. Gamers who are older seem more likely to use or prefer using avatars rather than their real names and those that have children may prefer to use their own identities.

6.4 Conclusions regarding the research question

The two sub-questions discussed above enabled the study to answer its research question. The study found that gaming does not influence DQ directly and that

demographic factors do not moderate the relationships. This study's findings start the debate on examining how the pervasiveness of gaming could be channelled to influencing digital cognitive development in the South African workforce. This is considering the benefits that other disciplines have derived from gaming as outlined in Chapter 2 of the literature review. This notion is also in line with assertions by DQ institute (2022), and Wisniewski-Pa (2018), who affirm that more knowledge about the development of digital competencies is required to meet the needs of the 21st century.

The findings of this study indicate that future studies investigating the influence of gaming on DQ should include the exogenous factors identified in Chapter 5 above, as well as the predictor variables identified in the linear models chosen for each DQ variable in Chapter 4. Previous research indicates that the moderating effects of demographics on the relationship between gaming and cognitive benefits are not fully known and that more research is needed in this area.

6.5 Recommendations

This section forms the second part of the chapter. It sets out recommendations in line with the study's analysis and results. The following recommendations are formulated from the learnings and gaps identified through this study:

6.5.1 *Exogenous Factors*

The study brought to the surface the notion that exogenous factors may have a stronger influence on DQ development than gaming in isolation. Therefore, it is recommended that organisation's planning to adopt gaming as a medium of learning to develop digital skills use theoretical models such as the CASTLE model to fully understand all the factors that reside outside of gaming that may influence the development of such competencies in their organisational setting, (Schneide, Beege, Nebel, Schuabert, and Rey, 2021).

6.5.2 *The use of Avatars*

The study found that gamers had lower digital identity. This finding is in line with assertions by other researchers who have asserted gaming is a social interaction and therefore gamers may not associate it with serious or official activities. The question of the implication of this finding for gaming in the workplace may not be clear due to the requirement to distinctly identify employees accessing computer systems for security reasons. Parallel to this the paradigm that points to the use of work avatars shows results that include reduced cognitive workload, high levels of accuracy, and increased employee retention in previous studies, (Qiu, Bozzon, Birk, & Gadiraj 2021).

6.5.3 *Adaptation of the DQ Quotient*

If arguments that DQ is the cognitive requirement of the digital age, and by extension today's digital workplace, it is recommended that the DQ quotient be adapted further, (Adams, 2004; Cismaru et al., 2018; Grasser et al., 2018; Marnewick & Marnewick, 2021a; Martin, Ventayen, Patacsil, & Patacsil, 2021; Moreno et al., 2019; Wiśniewska-Paź, 2018). The following recommendations may assist in further strengthening the DQ measure and making it better suited for us in the workplace.

- **Customize the Test**: The DQ test could be customized to assess specific competencies and skills required in the workplace. For example, the test could assess an individual's proficiency in using specific software applications, communication tools, or project management systems.
- **Scenario-based Questions**: The test could include scenario-based questions that simulate real-world workplace situations. This would enable employers to evaluate an individual's ability to apply digital intelligence skills in practical situations.
- **Interactive Testing:** The test could include interactive elements, such as simulations or games, that engage individuals in active problem-solving and decision-making. This would provide a more engaging and immersive

testing experience while also evaluating an individual's cognitive and affective factors in using digital technologies.

- **Continuous Assessment:** The DQ test could be integrated with ongoing workplace assessments, such as performance evaluations or training programs. This would provide a more holistic view of an individual's digital intelligence, as well as facilitate targeted interventions to enhance digital intelligence skills.
- **Multilingual Options:** The DQ test could be made available in multiple languages to ensure that it can be used for workplace assessments in different regions and among diverse populations.

Customizing the DQ test, including scenario-based questions, incorporating interactive elements, continuous assessment, and providing multilingual options can enhance its applicability for workplace assessments. Employers could use the DQ test to identify areas for improvement, provide targeted training, and select employees with the requisite digital intelligence skills for specific job roles**.**

6.6 Suggestions for further research

The present study has examined the influence of gaming on digital intelligence (DQ), providing valuable insights into this relationship. However, several potential avenues for future research can build upon and extend the current findings. Some suggestions for further research include the following:

6.6.1 *Examining the influence of gaming against an adapted DQ Quotient for the Workplace.*

A potential area of research could involve adapting the DQ Quotient for specific workplace contexts, allowing for a more nuanced understanding of how gaming influences digital intelligence within professional settings. This would enable researchers to assess the transferability of gaming-related skills to the workplace and how these skills contribute to employee performance and productivity.

6.6.2 *Inclusion of Exogenous Factors*

Future studies should consider including exogenous factors that may influence the relationship between gaming and DQ. By accounting for additional factors such as socio-economic status, educational background, and access to technology, researchers can better understand the complex interplay between gaming and DQ and identify potential confounding variables that may impact the observed relationships.

6.6.3 *Examination of Cause-and-Effect Relationships*

Further research should aim to examine the cause-and-effect relationships between gaming, exogenous factors, and DQ. This could involve conducting experimental or quasi-experimental studies to assess the causal mechanisms that underlie the observed associations and to explore potential mediators or moderators in the gaming-DQ relationship.

6.6.4 *Longitudinal Studies*

To better understand the long-term effects of gaming on DQ in the workplace, longitudinal studies should be conducted. By tracking participants over time, researchers can examine how the relationship between gaming and DQ evolves and how it may be influenced by various factors such as career progression, changes in technology, and workplace dynamics.

6.6.5 *Larger Sample Sizes and Demographic Factors*

Future research could benefit from using larger sample sizes to investigate the role of demographic factors, such as age, gender, and cultural background, as potential mediators in the relationship between gaming and DQ. This would allow for more sensitive and nuanced analyses that can account for the diverse experiences and perspectives of gamers and non-gamers alike.

6.6.6 *Biased Sampling for More Representative Samples*

Researchers could consider using biased sampling techniques to obtain more representative samples of gamers and non-gamers. This approach would help ensure that the study findings are generalizable to the broader population and may reveal important differences between gaming subgroups that can inform targeted interventions and strategies.

6.6.7 *Qualitative Studies*

Qualitative research methods, such as interviews, focus groups, or case studies, should be employed to gain deeper insights into the motivations and incentives that drive both gaming behaviour and DQ development in the workplace. This approach can provide a richer understanding of the lived experiences of gamers and non-gamers, shedding light on the complex and dynamic relationship between gaming and digital intelligence.

6.6.8 *Direct observation of gaming*

Lastly, because this study placed reliance on the participants' estimation of how much gaming they did, these estimates may have been inaccurate. It is recommended that future research into the construct of gaming and DQ development use direct observation to measure actual gaming experience. Technologies such as analytics could be used to extract results. In addition, data derived directly from the game such as the gamers' proficiency and duration could be measured against a participant's DQ over time.

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APPENDIX (A) Participation Information

Block 1

Dear participant,

Please note that all responses are **completely anonymous,** are treated with the **upmost confidentiality,** and are used for **research purposes only.**

Thank you for participating in this research study; your contribution is important. This research project is being conducted by Lawrence Kanotsauka. The research project investigates "The influence of gaming on digital intelligence in South African organisations". The collected data will only be used for research purposes and will be kept strictly confidential. Upon completion of the study, I will gladly share the results with you if you so desire. To proceed with the questionnaire, please provide your consent below. The research project has been explained to me, and I am aware of my role as a participant

If you have any additional questions or concerns, please contact me or my supervisor.

Thank you for your time.

Yours sincerely Researcher: Lawrence Kanotsauka
1084081@students.wits.ac.za

Supervisor: Prof Gregory Lee
gregory.lee@wits.ac.za

Please click the relevant options below before clicking on **next** to begin:

	Yes	No
I understand that my participation will remain anonymous	○	○
I understand that my participation is voluntary.	○	○
I agree that the information I provide may be used for research purposes.	○	○

APPENDIX (B) Instrument

Block 2

Do you or have you in the past played Video games which could include **mobile games**, **console games**, **pc games**, etc?

- ○ Yes
- ○ No

In total **how many years**' experience do you have playing video games?

- ○ 0-2
- ○ 3-5
- ○ 6-8
- ○ 9-11
- ○ 12 or more

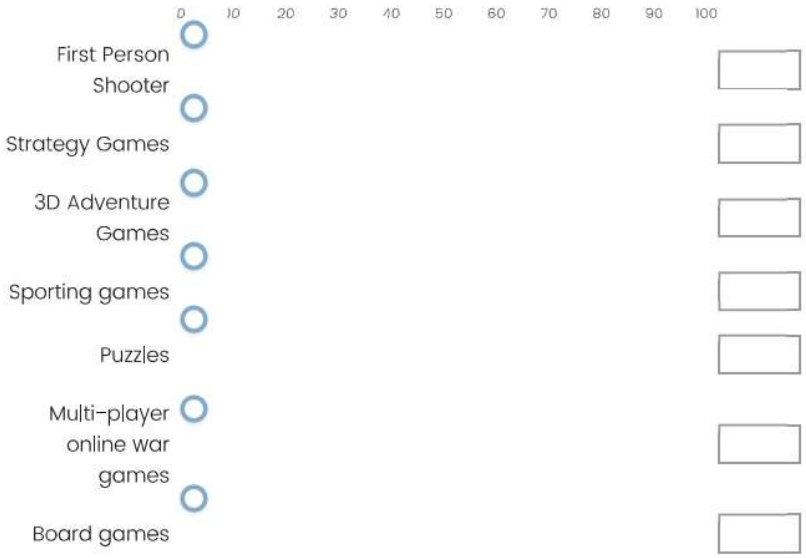
In total **how many hours per week** do you spend playing video games?

- ○ 0-1
- ○ 2-3
- ○ 4-5
- ○ 6-7
- ○ 8 or more

To your best estimate, **how many times** do you play video games per week?

- ○ 0-2
- ○ 3-5
- ○ 6-8
- ○ 9-11
- ○ 12 or more

Please indicate as a percentage (%) the amount of time **you spend or have spent playing the type of games below**. Slide the bar to make your selection.



Block 5

We would like to ask you some questions concerning your **digital life**. Please answer all questions by making a choice between **1=Strongly disagree** and **7=Strongly Agree** .

Block 3

Digital Identity

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
I use my real name for setting social network profiles	○	○	○	○	○	○	○
I use my own picture in my profile	○	○	○	○	○	○	○
I will offer explanations if people disagree with me on digital media (Facebook, Instagram, internet)	○	○	○	○	○	○	○

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
I will cease to communicate with people whose behavior is inappropriate for digital media	○	○	○	○	○	○	○

Digital Use

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
I do not surf or browse digital media during working hours	○	○	○	○	○	○	○
I allocate time to use digital media	○	○	○	○	○	○	○

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
I use digital media for working or for developing myself	○	○	○	○	○	○	○
I do not use digital media during family time	○	○	○	○	○	○	○

Digital Safety

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
If I feel threatened by people on digital media, I will avoid or stop communication	○	○	○	○	○	○	○

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
If I am bullied by words or pictures on digital media, I will avoid or stop	○	○	○	○	○	○	○
If someone asks for my personal information on digital media, I will avoid or stop the communication	○	○	○	○	○	○	○
I do not browse rude content and pornographic websites	○	○	○	○	○	○	○

Digital Security

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
I know when a threat occurs in digital media	○	○	○	○	○	○	○
I use programs to inspect the threats that affect digital media damage	○	○	○	○	○	○	○
I do not respond or communicate with people or suspicious things that threaten my digital media security	○	○	○	○	○	○	○
I create passwords that no one can know to protect my digital media security	○	○	○	○	○	○	○

Digital Emotional Intelligence

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
I acknowledge the feelings of others when they post sad messages and I reply to cheer them up	○	○	○	○	○	○	○
If someone posts a message asking for help, I will post suggestions back to him/her	○	○	○	○	○	○	○
I use digital media to show my feelings of worry about friends and acquaintances	○	○	○	○	○	○	○

Digital Communication

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
I greet and ask about friends and acquaintances With polite words	○	○	○	○	○	○	○
I use digital media as one channel for Working With other people	○	○	○	○	○	○	○
I assign or inquire about work from friends via digital media	○	○	○	○	○	○	○
Digital media allow me to work with friends efficiently	○	○	○	○	○	○	○

Digital Literacy

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
I use digital media to search for information at work	○	○	○	○	○	○	○
I select only reliable and valid sources of information from digital media	○	○	○	○	○	○	○
Information searched from digital media increases my working efficiency	○	○	○	○	○	○	○
I share knowledge from digital media with others	○	○	○	○	○	○	○
Information from digital media helps me to separate data or facts before making decisions	○	○	○	○	○	○	○

Digital Rights

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
If I use the work of others, I always reference the owner or sources	○	○	○	○	○	○	○
When sharing information in digital media I do not violate privacy rights and laws	○	○	○	○	○	○	○
I do not download software or movies that have copyright	○	○	○	○	○	○	○
I express my opinions on digital media but do not refer to other people	○	○	○	○	○	○	○

	Strongly disagree 1	Disagree 2	Somewhat disagree 3	Neither agree nor disagree 4	Somewhat agree 5	Agree 6	Strongly agree 7
I understand that items communicated in digital media are the responsibility of the society	○	○	○	○	○	○	○

Block 4

Please select your Race

- ○ Asian
- ○ Black
- ○ White
- ○ Colored
- ○ [ ] Other

Please indicate your gender

- ○ Male
- ○ Female

- ○ Non-binary / third gender
- ○ Prefer not to say

Please select the year of your birth

Do you have children?

- ○ No
- ○ Yes

Please indicate your highest level of education?

- ○ Below Grade 12
- ○ Grade 12
- ○ Certificate/Certification
- ○ Diploma
- ○ Under Graduate Degree or Equivalent
- ○ Post Graduate Degree or Diploma
- ○ PHD

Are you presently employed

- ○ No
- ○ Yes

What best matches your current employment status?

- ○ Full time employee
- ○ Part time employee
- ○ Independent business owner
- ○ Job-seeker
- ○ [ ] Other

Please make the selection that best describes the position you currently occupy.

- ○ Staff
- ○ Senior Staff
- ○ Supervisor/Manager
- ○ Senior Supervisor/Manager
- ○ Executive Manager

In which Industry are you presently employed?

- ○ Advertising and Media
- ○ Aerospace and Defence
- ○ Animal Care
- ○ Architecture and Urban Planning
- ○ Arts, Entertainment and Recreation
- ○ Audiovisual and Multimedia
- ○ Auditing and Accounting
- ○ Automotive
- ○ Chemical
- ○ Engineering
- ○ Construction
- ○ Consumer and Retail
- ○ E-commerce
- ○ Education
- ○ Energy
- ○ Farming and Agriculture
- ○ Financial services and Banking
- ○ Health, wellness and Fitness
- ○ Insurance
- ○ Information Technology and Telecommunications
- ○ Legal Services
- ○ Logistics and Supply Chain
- ○ Management and Strategy Consulting
- ○ Manufacturing
- ○ Mining and Metals

- ○ Transportation
- ○ Tourism and Hospitality
- ○ Utilities
- ○ Government and State Owned Enterprises
- ○ [ ] Other

Are you in the field of Information Technology?

- ○ No
- ○ Yes

How many years experience do you have in the IT field?

[ ]

Please move the slider to indicate the time you spend on computer based work in your job

APPENDIX (C) DQ Quotient

Items	Notation	Description
1	DG 1	I use my real name for setting social network profiles
2	DG 2	I use my own picture in my profile
3	DG 3	I will offer explanations if people disagree with me on digital media (Facebook, Instagram, internet)
4	DG 4	I will cease to communicate with people whose behaviour is inappropriate for digital media
5	DG 5	I do not surf or browse digital media during working hours
6	DG 6	I allocate time to use digital media
7	DG 7	I use digital media for working or for developing myself
8	DG 8	I do not use digital media during family time
9	DG 9	If I feel threatened by people on digital media I will avoid or stop communication
10	DG 10	If I am bullied by words or pictures on digital media I will avoid or stop communication
11	DG 11	If someone asks for my personal information on digital media I will avoid or stop the communication
12	DG 12	I do not browse rude content and pornographic websites
13	DG 13	I know when a threat occurs in digital media
14	DG 14	I use programs to inspect the threats that affect digital media damage
15	DG 15	I do not respond or communicate with people or suspicious things that threaten my digital media security
16	DG 16	I create passwords that no one can know to protect my digital media security
17	DG 17	I acknowledge the feelings of others when they post sad messages and I reply to cheer them up
18	DG 18	If someone posts a message asking for help, I will post suggestions back to him/her
19	DG 19	I use digital media to show my feelings of worry about friends and acquaintances
20	DG 20	I greet and ask about friends and acquaintances with polite words
21	DG 21	I use digital media as one channel for working with other people
22	DG 22	I assign or inquire about work from friends via digital media
23	DG 23	Digital media allow me to work with friends efficiently
24	DG 24	I use digital media to search for information at work
25	DG 25	I select only reliable and valid sources of information from digital media
26	DG 26	Information searched from digital media increases my working efficiency
27	DG 27	I share knowledge from digital media with others
28	DG 28	Information from digital media helps me to separate data or facts before making decisions
29	DG 29	If I use the work of others, I always reference the owner or sources
30	DG 30	When sharing information in digital media I do not violate privacy rights and laws
31	DG 31	I do not download software or movies that have copyright
32	DG 32	I express my opinions on digital media but do not refer to other people
33	DG 33	I understand that items communicated in digital media are the responsibility of the society

(Na-Nan et al., 2020)

APPENDIX (D) Ethics Clearance

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/DB1084081/681
This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

Project title	The influence of gaming on digital intelligence in South African organisations
Investigator / Researcher	Mr Lawrence Kanotsauka
Nature of Project	MM (Digital Business)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed anonymity and confidentiality.
Issue Date of Certificate	2022-12-19
Expiry date	Date of submission of the project / research report
Chairperson	Prof Anthony Stacey ☎ +27 11 717 3587 +27 82 880 4531 anthony.stacey@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

Signature

2022-12-21
Date:

APPENDIX (E) Title Approval

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050
Fax:
Tel:

Reference: Ms Jennifer Mgolodela
E-mail: jennifer.mgolodela@wits.ac.za

06 January 2023
Person No: 1084081
PAG

Mr L Kanotsauka
57 Stonefields
Cedar Avenue West
Maroeladal Ext 12
2191
South Africa

Dear Mr Lawrence Kanotsauka

Master of Management: Approval of Title

We have pleasure in advising that your proposal entitled *The influence of gaming on digital intelligence in South African organisations* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Marike Bosman
Faculty Registrar
Faculty of Commerce, Law and Management