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INYUVESI YAKWAZULU-NATALI

EXPLORING LECTURERS' UNDERSTANDING OF TURNITIN UTILISATION IN ASSESSING MATHEMATICS AT A SOUTH AFRICAN UNIVERSITY

By

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This thesis is submitted in fulfilment of the requirements for a Doctor of Philosophy degree in Curriculum Studies

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SUPERVISOR'S STATEMENT

This dissertation has been submitted with my approval.

18/06/2020

DECLARATION

I, Tinyiko Hopedivine Zuma, declare that:

1. The research reported in this thesis, except where otherwise indicated, is my original research.
2. This thesis has not been submitted for any degree or examination at any other university.
3. This thesis does not contain other persons' data, picture, graphs, or other information, unless specifically acknowledged as being sourced from other persons.
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a. Their words have been rewritten, but the general information attributed to them has been referenced.

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Dedication

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Abstract

This study explores lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university. The qualitative study is also aimed at exploring what, how and why lecturers understand Turnitin utilisation in assessing mathematics in a particular manner. An interpretive paradigm and case study were used on four participants to gain the meaning in a real situation. To generate data needed to respond to the research questions in the study, the following instruments were used: reflective activity, document analysis, and individual semi-structured interviews. Purposive and convenience sampling were employed in order to reach the closest participants who were easily accessible, acquiring from them in-depth data. The generated data were analysed guided by TPACK theoretical framework concepts for this study. The concepts were content and activities, methods, assessment, resources, and lecturers' role. The findings reveal that, there are two ways of utilising Turnitin in mathematics, which need to be integrated, namely, technology detection (TD), and manual detection (MD). TD and MD require lecturers' understanding of content knowledge (CK) in mathematics. These findings indicate that assessment of content in mathematics requires the integration of TDCKM and MDCKM, for understanding to be effective and sustainable. Consequently, the study recommends that the case study be adopted in other studies to explore its effectiveness for mathematics, with the purpose of reviewing the plagiarism policy vision in terms of Turnitin utilisation. The study concluded that, although lecturers were aware of the utilisation of Turnitin, their knowledge was dominated by personal understanding, because of the commonalities of numbers, symbols, terminologies, and vocabulary, equations, tables, theorems, and graphs assessed in mathematics

It is noticed that this study was the first to use the case study in gaining information on lecturers' understanding of Turnitin utilisation in assessing mathematics at a SA university. It is recommended that the case study be adopted to understand the in-depth situation. It is also recommended that the case study be adopted in other studies to explore its effectiveness for mathematics, with a purpose of reviewing the plagiarism policy vision in terms of Turnitin utilisation. The findings of this research should therefore be enlightening to various training

institutional stakeholders in KwaZulu-Natal in promoting the use of the case study in different contexts and learning areas similar to mathematics.

Keywords: assessment; content; detection; knowledge; manual; mathematics; pedagogy; plagiarism; technology; Turnitin; similarities; software; understanding; utilisation.

CHAPTER 1: THE OVERVIEW, CONTEXT, AND OBJECTIVES

1.1 Introduction

This chapter provides an outline and overview of the whole research, highlighting the main concerns in each of the six chapters. The literature review, methodology, and the research findings supported the exploring of lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university. This chapter presents an exploration of the background, rationale, statement of the problem, and information that is aligned with and focused on the purpose of the study. Personal experiences that directed the research will be elaborated on.

1. 2 Context and Background of the Study

Today it is easy to obtain vast amounts of information from the Internet and the World Wide Web that would have been difficult to imagine even 10 years ago. The available material involves text sources, images, music, and videos (Razon, Tan, Promentilla, Aviso, & Yu, 2017). As a result of easy access to information, copy and pasting and plagiarism have become widespread behaviour, especially in university-level education (Özbek, 2016). Thompsett and Ahluwalia (2015) affirm that plagiarism is not new; and its foundations are steeped in the historical dilemma as one of the unpleasant issues associated with higher education. Cabral (2019) reminds that the word plagiarism comes from the Latin, and refers to abducting, kidnapping or seducing. It is serious academic misconduct to duplicate words or ideas of another, making them own ideas (Pradhan & Pradhan, 2017). According to Khan (2012), plagiarism is a world-wide phenomenon encompassing almost all fields of life. Plagiarism is reported in higher education in Pakistan (Rashid & Rashid, 2018). The findings from a study conducted by Pradhan and Pradhan (2017) indicate that, in India, plagiarism is considered unethical, and such must be eliminated from the community. In addition, in Germany, there have been occurrences of plagiarism and other unethical research practices since the late 19th century (Jereb et al., 2018). Furthermore, plagiarism exists in Nigeria, with the arrival of the Internet making cheating easy (Ukpebor & Ogbebor, 2013). A study by Appiah (2016) reveals that, in the public universities in Kumasi metropolis of Ghana, there is a high prevalence of plagiarism.

There are many cases of plagiarism in almost every university of the country. Universities and higher institutions have decided to use a variety of software in order to detect plagiarism. Such software includes: iThenticate, Viper, Dupli Checker, Plagiarism Checker, PlagScan, Copyleaks, Plagium, Apachelucene, SafeAssign; PaperRater, Source code, Urkund; Plagiarisma, and Dustball, among others (Ali, Abdulla, & Snasel, 2011; Alsmadi, Alhami, & Kazakzeh, 2014; Chowdhury & Bhattacharyya, 2016; Hiremath & Otari, 2014; Jharotia, 2018; Joshi & Khanna, 2013; Naik, Landge, & Mahender, 2015; Saini, Bahl, Kumari, & Singh, 2016; Singh, 2016). Such plagiarism-detection software is offered to the institutions at an annual subscription, while others are available at no cost (Walchuk, 2016).

Turnitin software is a text-matching tool that analyses a document for its similarity with digitally available content on the Internet (Rashid & Rashid, 2018). Turnitin was founded in 1998 by four UC Berkeley students. It provides originality checking, online grading, and peer review in a single service. Many institutions and universities use Turnitin to improve the quality of theoretical research (Jharotia, 2018). In addition, Turnitin is used by over 15 000 institutions worldwide, involving over 600 million student papers in over 150 countries. Turnitin also offers a service called WriteCheck for students to test their own papers against their system, charging $6.00-$8.00 per paper scanned (Al-Shamaa, Brown, & Pranish, 2017; Snider, 2018). Turnitin is designed around international standards of referencing writing conventions and styles (Rashid & Rashid, 2018). Turnitin is also used in many countries such as South America, North America, Sri Lanka, United Kingdom, United States, Germany, India, Pakistan, Ghana, Nigeria, and South Africa (Abrahamson & Mann, 2018; Appiah, 2016; Bemmel, 2014; Jereb et al., 2018; Mphahlele & McKanna, 2019; Pradana, Karim, Erry, & Bustani, 2019; Ranawella & Alagaratnam, 2017; Singh, 2016; Ukpebor & Ogbebor, 2013). Most universities around the world including South Africa use Turnitin software as part of their approach to managing plagiarism (Khoza, 2015b; Mphahlele & McKenna, 2019).

The literature reveals that there is confusion about the utilisation of Turnitin. It is indicated that Turnitin does not identify plagiarism, but rather compares the content of students' submissions (Thompsett & Ahluwalia, 2015). In addition, Turnitin compares the text content, which has been uploaded onto the Turnitin website, and matches it to the Internet and other previously submitted

texts, resulting in similarities (Thompsett & Ahluwalia, 2015). Turnitin is very powerful software for checking plagiarism in large documents on billions of resources which might check 440 pages at a time. It was specifically developed for the educational system (Singh, 2016). The studies indicate that Turnitin is the most popular detection software for checking plagiarism, despite not being free of charge, being designed for educational purposes.

However, Turnitin is found not to be as good as manual detection, especially in detecting mathematics content (Joshi & Khanna, 2013). Turnitin does not work well on the content of mathematics, since the content of mathematics involves mathematical formulae and equations, numbers, tables, common expressions, and graphs (Oghigian, Rayner, & Chujo, 2016; Reporter, 2016). For example, if students have to determine the cosine of an angle on the given document, and the students upload their work to Turnitin, Turnitin flags the similarity (Saini et al., 2016). This similarity index is open to lecturers' comprehension and interpretation (Rashid & Rashid, 2018). In other words, it is for the lecturer to decide on the presence of plagiarism, similarity, and referencing issues (Rashid & Rashid, 2018). Generally, this indicates that the lecturer has to use his or her understanding of content knowledge with technological knowledge. Lecturers have to integrate manual and technological detection, indicating personal and professional understanding. In this case, I disagree with Joshi and Khanna (2013), who state that Turnitin is not as good as manual detection. This suggests that Turnitin and manual detection work well when integrated. Integration of manual and Turnitin software assists lecturers in assessing student work, providing effective feedback with respect to any similar string of words matching the reported work (Chauhan, 2017). In addition, to the original report, Turnitin produces the similarity score of the text in the submission that is found to match those in other papers (Razon et al., 2017). Usually, Turnitin software indicates green up to 24% score; yellow to brown for 25–74% and red for 75–100% score; which amounts to a critical situation of the text (Suseela, 2016). These scores are guidelines to assist lecturers when reviewing students' text. For this reason, it is important to examine the reports logically, rather than relying only on a generated score (Suseela, 2016). However, the findings from the study conducted by Havemann and Sherman (2017) indicate that paper-based marking still exists at the UCL Institute of Education and offline; however, on-screen marking on laptops is on the increase. This statement concurs with the findings of this study; lecturers teaching mathematics are still using paper-based marking as well as offline marking.

This confusion raises the question of how mathematics lecturers will cope with the shift from the Third Industrial Revolution to the Fourth Industrial Revolution (4IR), while there is still a gap in utilising technology on content and pedagogical knowledge. Turnitin is part of the 4IR. For example, in Bloomsbury, Turnitin is programmed in such a way that it allows for audio feedback. However, it is reported that uptake of this option is very low (Havemann & Sherman, 2017). This could be the result of the lack of modification of the policy to suit mathematics specifically, in terms of utilising Turnitin. The University of KwaZulu-Natal plagiarism policy does not specify the software to be utilised in checking mathematics; nor does it indicate whether it is compulsory to utilise Turnitin in mathematics. There is a gap between mathematics students and the use of Turnitin, because of lecturer uncertainty (Rashid & Rashid, 2018). However, the uncertain lecturers might not cope in the era of any industrial revolution which brings fundamental changes into the structure of the labour force (Gora, 2017). This also suggests that Turnitin is associated with the 4IR, which uses artificial intelligence by means of the Internet.

Moving forward, Schwab (2016) maintains that, regardless of the challenges we face today, the most important thing is to understand and shape the new technology revolution, which entails a transformation of humankind. This transformation will be subject to new requirements towards staff (Gora, 2017). Generally, the core mission of education does not change, regardless of whatever era (Xing & Marwala, 2017). It is therefore necessary for the universities to be prepared for the changes that are brought into the 4IR, as this technological revolution will alter the way we live, work, and relate to one another (Chung & Kim, 2016). As a result, these changes indicate the importance of understanding and being prepared for the requirements of the market; that is, to teach and acquire the knowledge and skills needed in the new technological structure of society (Gora, 2017).

1.3 Candidate Statement

This statement gives a short narrative of my personal experience as a South African teacher, desirous of extending my profession (professional), personal life (private), and community (public) understanding, in order to make a mark in education and on society at large. I am a qualified teacher who always strives for self-development to contribute to society. I am an experienced

teacher, having started teaching in a foundation phase with a primary diploma. I was dedicated to my work. I rose to departmental head in the foundation phase. I later upgraded to a higher diploma in education, specialising in Natural Science at a local college. I had to leave the foundation phase and teach in the intermediate phase because of the school-curriculum needs. I did not stop; I then pursued my career by enrolling for the Bachelor of Education degree in Education in Science at the local university. Being promoted as a departmental head, I had to have leadership and management skills. I further enrolled for a certificate in Adult Basic Education and Training; as well as an honours degree in leadership and management at a local university. These skills enabled me to strengthen and manage teaching and learning by supporting educators to improve their teaching. I later had to teach mathematics in the intermediate phase. I noticed that there was a problem with competence in the performance curriculum. By that time I sought to explore teaching strategies in mathematics in the intermediate phase. I then enrolled for a master's degree at a local university. Three months of acting as a principal did not hinder me in teaching and pursuing my studies. I have a passion for improving mathematics in our learners. Mathematics is a failing subject in South Africa. I had noticed that, at primary level, most often, mathematics is taught by educators who lack content knowledge as well as technological knowledge of teaching mathematics. That on its own is in question in this era of the 4IR. Teaching and learning must undergo a shift to transformation which requires integration of content and pedagogy with technology in mathematics. Most teachers of my age who were born before the introduction of technology find it a challenge to teach and assess through technology. It is noteworthy that, while doing my master's degree I was introduced to Turnitin for use in mathematics. That experience encouraged me, as a member of the school management team, to take a lead in pursuing my PhD studies, in order to return and contribute at grassroots level, improving the assessment of mathematics by using Turnitin.

My intention in undertaking this study was to explore lecturers' understanding of Turnitin utilisation from the existing literature in mathematics. The purpose was to make a contribution to lecturers, students in universities, as well as in schools, in terms of assessment. Readers will already know that assessing students or learners of mathematics per Turnitin is possible for marking a pile of papers in a short period. In addition, this study might change lecturers' minds once they understand Turnitin software as an assessment tool for checking the correctness of the

content, rather than as a tool for checking plagiarism in mathematics. Moreover, the contribution made by this study is that Turnitin works well with the integration of manual detection. In other words, the study shows the importance of integrating content and pedagogy with technology. Furthermore, the study revealed the importance of taking note of the three propositions of Turnitin in mathematics. It indicated that, as lecturers or teachers, we are driven by disciplinary (professional), personal (private), and societal (public) understanding to accommodate diversity in, and to achieve the required goals of teaching and learning. Lastly, the study indicates the importance of taking note of the three propositions.

1.4 Rationale of the Study

This study is about the lecturers' understanding of Turnitin. The concept of understanding in this study means the lecturers' ability to reflect on their understanding, in order to interpret the similarities detected from Turnitin. Buckley and Cowap (2013) observed that lecturers should use their understanding to interpret the information, determining whether students followed proper citation standards. When I was taking my Master's degree, I discovered many similarities. I had to reduce some information to decrease similarities detected on my project. Moreover, the text was affected because I had to reduce the high percentage of Plagiarism−I was daunted by the high percentage given by Turnitin. At the same time, Turnitin would always indicate that I had exceeded 10%; the percentage had nothing to do with plagiarism. It is safe to say that it is not always reliable. An individual lecturer utilises Turnitin according to his or her own understanding and experiences, and the way the individual interprets the intended curriculum (Khoza, 2015a, 2015b). Lecturers need to understand that students might plagiarise but have plagiarism cited at 1%; on the other hand, one might not plagiarise and but be considered as plagiarising 10% (Khoza, 2015b). Hence, lecturers' understanding of Turnitin utilisation becomes effective when confronted by such dilemmas. Lecturers must become aware of and avoid the major weaknesses posed by Turnitin (Khoza, 2015b). I had an understanding of Turnitin I would have not attempted to delete any information like tables and formulae from of my study on mathematics. Likewise, Khoza (2015b) asserted that the exceeded percentage reflects the use of templates or standard tables. This suggests that there is a need for the study to explore lecturers' understanding of Turnitin utilisation in assessing mathematics.

Plagiarism has been rapidly growing in this era of technology. Students are using technological opportunities to acquire someone else's work, submitting it as their own work. This fraudulent behaviour of students in tertiary higher-learning institutions and universities is of great concern today in the era of the Internet (Eret & Ok, 2014). The problem of plagiarism in developing countries like South Africa is huge, such that most assignments, in particular, take-home assignments, and the thesis/dissertation, contain elements of plagiarism. Plagiarism problems led to the development of the Turnitin programme by John M. Barrie, when he was a graduate student at the University of California (Berkeley) (Ison, 2014). Utilisation of Turnitin is recommended by almost all universities to control plagiarism. Lecturers are therefore compelled to utilise Turnitin. In South Africa, there are a few schools that expose teachers to Turnitin in order to prepare them to lecture at university level (Khoza, 2015b). Therefore, it is important for both lecturers and students to have an understanding of Turnitin utilisation. Lecturers' understanding of Turnitin utilisation differs, being reliant on individual understanding.

Lecturers should understand that utilisation of Turnitin is categorised for three reasons (Batane, 2010; Boud & Falchikov, 2006; Buckley & Cowap, 2013; Kehdinga, 2014a; Rolfe, 2011). One of these reasons is for educational purposes, or private utilisation. In private utilisation, Turnitin is utilised for developing individual knowledge, skills, and attitudes/values. In the light of the above, private utilisation of Turnitin, as a deterrent, helps students think about their writing. The aim of utilising Turnitin is to implement electronic submission of assessment as a formative learning tool, allowing students to submit a draft, and have the chance of looking at their original reports before final submission.

The above studies further argue that the second reason for utilising Turnitin is for punitive purposes, the professional reason. This reason follows the education policy of utilising Turnitin to punish students who plagiarise. Professional utilisation of Turnitin is identified by the curriculum, in which students learn the same body of knowledge from the lower level to the higher level (Khoza, 2016). In addition, the studies argue that consequences of punishment that does not condone plagiarism must be reinforced, so that those observing are discouraged from imitating such unacceptable behaviour (Batane, 2010). The author further argues that, in professional utilisation, serious measures are taken to penalise students for plagiarism. in professional utilisation of Turnitin, if students are caught plagiarising, they are punished by being given no

marks at all; or given the chance to start an assignment or project all over again, depending on decisions made by the institution (Youmans, 2011).

The third reason raised that is guided by the opinion of others is known as public utilisation (Kehdinga, 2014b; Nkohla, 2017). In public utilisation of Turnitin, decisions are influenced by opinions, general knowledge, and oral conversation (Khoza, 2015a). Turnitin detects and shares with other people how to deal with plagiarism issues (Kehdinga, 2014a; Nkohla, 2017). In other words, in public utilisation of Turnitin, lecturers detect and share the reports of students presented by Turnitin in which they have concerns regarding plagiarism (Graham-Matheson & Starr, 2013). This indicates that some lecturers depend on those who are good at utilising Turnitin, based on their daily knowledge (Hoadley & Jansen, 2014; Khoza, 2015b). As a result, such lecturers learn through consequences of actions and social modelling (Batane, 2010). Those lecturers who detect and take decisions from other people might utilise Turnitin for the wrong reasons to stand against any element of teaching and learning (Khoza, 2015d).

The literature above indicates that the three reasons for utilising Turnitin have their own positions in the curriculum. If the curriculum is driven by private reasons for utilising Turnitin, it addresses the identified consequences of plagiarism and educates students (Penketh & Beaumont, 2014). This type of curriculum indicates the vision of utilising Turnitin as a formative teaching tool (Buckley & Cowap, 2013). If the curriculum is driven by professional reasons, the vision of utilising Turnitin is refined by the content and curriculum policy to pass or fail students (Khoza 2015b). It is therefore determined by performance curriculum (Hoadley & Jansen, 2013; Khoza, 2016). If the curriculum is driven by public reasons for utilising Turnitin, this comes from society and understands the environment in which the students are located (Budden, 2017). According to Khoza (2016), this type of curriculum knowledge is mostly generated horizontally from local, known sources. Therefore, this type of curriculum does not help students to learn about utilising Turnitin formally, since they learn to utilise Turnitin from local experiences (Govender & Khoza, 2017). This study is guided by private utilisation of Turnitin.

This study might be of significance to those lecturers in the university who teach mathematics, to understand the reasons for utilising Turnitin on their current practices. Second, the results of the

study may also augment the level of support provided to students within universities on utilisation of Turnitin. Third, the higher education institutions, policy developers and policy-makers must use Turnitin to revisit policies that might benefit both lecturers and students. Furthermore, this study might assist in closing the gap between lecturers and students who misunderstand Turnitin utilisation. An individual attempt by lecturers might not be effective. There must be an active role played by the university board in order to improve the utilisation of Turnitin in teaching mathematics. The findings might therefore provide me with more information on lecturers' understanding of Turnitin utilisation.

1.5 Literature Review

Turnitin is one of the current digital technology (DT) resources that permits lecturers to motivate students to express their own ideas and not copy other people's work (Khoza, 2015b). The study conducted by Buckley and Cowap (2013) reveals that Turnitin is perceived as a way of detecting academic dishonesty in students' assignments and theses. Turnitin was introduced worldwide because plagiarism is common to many universities (Razi, 2015). As a result, to gain trust of students, many universities have adopted Turnitin software to detect plagiarism from student papers, hoping to instil ethics (Vanacker, 2011). In the words of Berkvens, van den Akker, and Brugman (2014); and Khoza (2016), Turnitin is utilised for three reasons, that is, for personal reasons, professional/content reasons, and societal reasons. In this study, personal reasons are represented by private utilisation of Turnitin, professional/content reasons are represented by professional utilisations, and societal reasons are represented by public utilisations. Turnitin is part of assessment. Assessment is one of the key components of the educational experience in the education curriculum (McCracken et al., 2011). According to Reddy and Le Grange (2017), assessment is considered the capacity to perceive students' ability with the view to understanding how they study to sustain their learning. According to Khoza (2015b) and McCracken et al. (2011), there are three types of assessment in teaching and learning, namely: summative assessment (professional utilisation), formative assessment (private utilisation), and peer assessment (public utilisation).

In buttressing this, a study of Boud and Falchikov (2006) indicates that professional utilisation assessment concentrates on the immediate needs of detection and punishment in teaching and

learning. It also addresses the immediate needs of certification. Private utilisation assessment concentrates on utilising Turnitin to identify suspected cases of plagiarism in order to improve the quality of students' writing, and their knowledge of plagiarism (Buckley & Cowap, 2013). Public utilisation assessment concentrates on attending the judgments of others in order to acquire a broader set of skills that enables lecturers to take decisions on students' work (Boud & Falchikov, 2006). However, in private utilisation assessments, lecturers utilise Turnitin to support students without necessarily grading them, but as part of learning and collecting relevant information concerning a thesis (Khoza, 2013a). In other words, teaching and learning does not have to segue from the higher level (professional assessment/detect and punish) to the lower level (private assessment/detect and educate) (Khoza, 2016). Private utilisation assessments are driven by personal, societal, and/or discipline visions (Khoza, 2015a, 2016). If a curriculum of assessment is dominated by summative and peer assessment, utilisation of Turnitin addresses the professional and public needs. However, if the curriculum is driven by formative assessment of utilising Turnitin, it addresses private (personal) needs which help the lecturers to understand the public and professional needs (Govender & Khoza, 2017; Ndlovu, 2017). Private utilisation assessments are about understanding one's identity before taking any action; so that one is able to decide whether the action is publicly or professionally driven (Ndlovu, 2017).

The implication is that those who implement the curriculum should first have an understanding of the various types of assessment that underpin the curriculum before the enactment process takes place. Understanding whether the curriculum in assessment is dominated by private, professional, or public needs increases the chances of achieving a positively attained curriculum because of good alignment between the intended curriculum and the implementers of the curriculum (Hoadley & Jansen, 2013; Khoza, 2013b). In South Africa, there is no law that compels all the universities to have initial training on utilising Turnitin before uploading text to Turnitin. Some universities see the need to organise workshops for lecturers' successful adoption of e-marking, and for improved understanding of utilising Turnitin (Buckley & Cowap, 2013). The policy does not clearly specify any private utilisation of assessment when lecturers adopt Turnitin. Lecturers who first utilise Turnitin as a formative tool report that students' work indicates less copy and pasting (Rolfe, 2011). In other words, higher education has an important role to play in preparing students to utilise Turnitin before submitting the final draft for assessment (Boud & Falchikov, 2006).

Unless students are supported with sufficient knowledge on the ethics of thesis writing, plagiarism will always be an issue (Savage,2004). According to Smith, Ghazali, and Siti (2007), plagiarism is the use of the ideas and words of others without the acknowledgement of the source of that information.

A study approach of Beasley (2004)'s used research process automation (RPA), which focuses on automating elements of the research and writing process, and more specifically, on the development of research work products. This approach reveals three types of plagiarism, after considering some of the causes of plagiarism. The first type is the accidental plagiarist − one who either does not understand plagiarism or makes a mistake in quoting, citing, or paraphrasing (professional understanding). The second type is the opportunistic plagiarist, one who knows that it is wrong to plagiarise, but does so anyway owing to disorganization, information overload, ethical lapses, laziness, or fear (private understanding). The third type is the committed plagiarist − one who intends, with forethought, to cheat, by stealing other scholars' ideas (public understanding). Plagiarists in the fourth category, as identified by Clough, Willett, and Lim (2015), are those who cite authors incorrectly. The accidental plagiarist must be taught how to quote, cite, and paraphrase. Such plagiarists need effective, intensive courses on improving writing skills (Ayon, 2017).

Assessment becomes very weak if it is not connected to all curriculum components or concepts (Khoza, 2015d; van den Akker et al., 2009). Khoza (2015d) and van den Akker et al. (2009) further state that curricular signals or components involve assessment, goals, content and activities, resources, lecturers, location, and accessibility. Utilisation of Turnitin indicates three components − technological, pedagogical and content knowledge (TPACK) (Mishra, Koehler, & Henriksen, 2010). The studies of Khoza (2012); Mishra et al. (2010); Kaput and Roschelle (2000) defined TPACK as technological knowledge (standards and advanced technologies such as, hardware, software, and ideological-ware), pedagogical knowledge (PK) (knowledge about assessment, teaching methods, lecturers, environment, and time) and content knowledge (CK) (subject matter, and teaching and learning activities that are taught and learned). Moreover, van den Akker et al. (2009) simplify these mentioned components in question form, so that they are better understood. The questions are as follows: Why are you assessing utilising Turnitin in mathematics

(rationale/vision)? Towards which goals are you assessing utilising Turnitin in mathematics (aims/objectives and teaching outcomes)? How do you assess utilising Turnitin in mathematics? (assessment); What and how are you assessing utilising Turnitin in mathematics? (content and activities); How do you assess utilising Turnitin in mathematics? (lecturer's role); When and where are you assess utilising Turnitin in mathematics? (location and time); and with what are you assessing utilising Turnitin in mathematics? (resources).

These concepts assist lecturers. As curriculum implementers, lecturers should first have a better understanding of Turnitin utilisation as a deterrent that underpins the intended assessment (Khoza, 2015d; van den Akker et al., 2009). This understanding affords lecturers the knowledge to solve the problem in real life (Hiatt,1994), such as fighting plagiarism by using TPACK concepts. For example, according to the University of KwaZulu-Natal's plagiarism policy, the rationale for utilising Turnitin is to attend to the matter of stealing. In the same vein, the quality assurance agency (QAA) has forced universities and higher education institutions to have effective measures set in place that deal with breaches in assessment regulations. Such most commonly deal with offences relating to plagiarism, for example, Turnitin (professional understanding) (Chew, Ding, & Rowell, 2015). Most lecturers are faced with unexpected policies, and they have to undergo a challenging transition to unfamiliar academic cultures and values (Graham-Matheson & Starr, 2013). The changes to the curriculum policies are therefore not static. The content of educational knowledge keeps changing (Hoadley & Jansen, 2013; Razi, 2015).

However, a study conducted by Berkvens et al. (2014) reveals that the excellence of syllabuses is established on the principal objectives that education experts consider important. According to Khoza (2015), goals are divided into aims, objectives, and outcomes. In this study, aims are represented by private understanding; objectives are represented by professional understanding; while outcomes are represented by public understanding. According to Khoza (2013b), objectives are designed according to the implementer's objectives, while aims are formed according to what lecturers want to cover during assessment (Kennedy, Hyland, & Ryan, 2006). On the other hand, learning outcomes are what students should learn in order to perform well in society (van den Akker et al., 2009).

A research study was carried out by Khoza (2015b) using qualitative critical action research on six Grade 12 learners who used Turnitin as part of their assessment processes Turnitin submissions. This study generated data through reflective activity, individual semi-structured interviews, and document analysis. The findings of the study reveal that, in most cases, the users of Turnitin use it to attain aims and objectives, ignoring the achievement of results. This means that the use of Turnitin is centred on professional and private understanding. In professional understanding, the goal of utilising Turnitin is to detect and punish, while the goal of utilising Turnitin in private understanding is to educate students with the aim of achieving better utilising of Turnitin (Buckley & Cowap, 2013). The study of Kennedy et al. (2006), summarises the developments in the curriculum design in higher education in recent decades. Drawing on recent practical experience, this study suggests a user-friendly methodology for writing modules, courses, and programmes, in terms of learning outcomes. This study reveals that the challenge for teachers is to ensure that there is alignment between assessment techniques, assessment criteria, and learning outcomes. In terms of this statement, if the lecturers do not involve students in utilising Turnitin, learning outcomes are not achieved. Thus the goals of utilising Turnitin are not balanced − there is a lack of public understanding. This also suggests that there is a need for such lecturers to delve deeper (Khoza, 2015d) in planning their assessment utilising Turnitin, in order to achieve learning outcomes. In that sense, lecturers would be able to challenge students to use Turnitin by means of implementing scrutiny, synthesis, and assessment (Kennedy et al., 2006).

Moving forward, the policy indicates that the goal of the University of KwaZulu-Natal plagiarism policy is to support the existing structures as well as the rules and regulations aimed at discouraging, preventing, detecting, reacting to and reducing the impact of plagiarism (Vithal, 2009). In support of this policy, the university conducts Turnitin training for staff members, lecturers, as well as for students. For example, Chetty (2014) conducted Turnitin training with the university in order to develop the above-mentioned university attendees. Lecturers who attend such Turnitin training programmes are empowered with the knowledge of Turnitin utilisation, to be on the same level as other universities who have adopted Turnitin to prevent plagiarism. As Glod (2006) points out, Turnitin is used by millions of individuals and thousands of institutions aiming to prevent plagiarism.

The studies above have indicated that utilising Turnitin is to check plagiarism in the hopes of preventing it. Turnitin training must apply to all who use it. The policy guides lecturers and students through rules and procedures of handling misconduct. However, the policy is not specific on the devices to be used in preventing plagiarism in order to achieve the goals of using Turnitin. As Vanacker (2011) argues, the goal of Turnitin is to catch a cheat or a misguided student. In both instances, the need for detection is equally important, even if the sanctions might be not the same. To avoid this behaviour, Rashid and Rashid (2018) suggest that lecturers focus on an attitudinal shift in teaching students about Turnitin, that would drive students towards the practice of originality, indicating professional understanding. The authors also point out that lecturers should let students experience using Turnitin themselves, reducing the fear of being judged per the Turnitin mechanism (Rashid & Rashid, 2018), displaying public understanding in order to achieve outcomes. There is the need to explore the development of a Turnitin policy and pedagogical user guide for Turnitin at universities, to ensure good understanding, and a consistent and standardised assessment by the lecturers (Roche, 2017). In this case, lecturers are able to meet individuals' needs by means of balancing professional and public understanding that might determine their private understanding. Such would avoid the tension that might be created between the lecturer and the students during assessment (Tyler, 2013; van den Akker, 2009). Generally, for the assessment to be effective, lecturers should understand curriculum concepts for Turnitin utilisation, in order to determine the goals (Khoza, 2016; van den Akker et al., 2009). However, the goal of utilising Turnitin is determined by resources.

A resource is defined as any person or device that imparts teaching and learning (Khoza, 2012). In teaching and learning there is a shift from traditional to scientific technology for practical purposes (Khoza, 2015d). According to Khoza (2015a), technology is categorised into two, namely: Technology in Education (TIE), and Technology of Education (TOE). TIE is also known as hardware (HW) and software (SW), while TOE is known as ideological-ware (IW) (Budden, 2017; Czerniewicz & Brown, 2014 ; Khoza, 2014b; Pather, 2017). In this study, hardware, software, and ideological-ware resources are suitable for assessing students' work in mathematics through Turnitin (Khoza, 2015b). The hardware resources, such as the laptop, are used in education in conjunction with the software resources, to display information. The software resources, for instance, Turnitin, GeoGebra, Google Classroom, Google Form, as well as Moodle, are innovative

tools for integrating technology into teaching and learning of mathematics (Bhagat & Yen Chang, 2014; Jones, Mackrell, & Stevenson, 2010; Khoza, 2017). On the other hand, ideological-ware is described as one's instruction that is impossible to be seen or handled, originating with the lecturer (Amory, 2010; Khoza, 2013a). In other words, ideological-ware involves instruction approaches, theories of assessment, instruction, as well as learning (Jones et al., 2010; Kapp, 2015; Khoza, 2018; Yildiz & Baltaci, 2016). The implication of this is that, for lecturers to use Turnitin in mathematics, they need to integrate hardware, software, and ideological-ware. The integration of these resources might assist lecturers to be able to help students to use their computers or laptops effectively to upload their work.

In addition, the literature reveals that software like GeoGebra makes it easy for lecturers and students to deal with geometry; and it also offers algebraic possibilities for entering equations directly (Hohenwarter & Fuchs, 2004). Furthermore, GeoGebra is used during assignments, projects, and examinations. The software also contains downloadable notes, formulae, worksheets, and remediation activities which are readily available for utilisation (Nepaya, 2019). Mathematics is therefore accomplished successfully through technology. Moreover, in this era of technology, there are areas of mathematics which depend on resources such as the computer for calculations. Some resources can draw tables, prove theorems, and use software like GeoGebra, relying also on lecturers' understanding (Dehaye et al., 2016; Khoza, 2016; Yildiz & Baltaci, 2016). However, Oghigian et al. (2016) argue that the usage of software like GeoGebra, in doing mathematics, would cause a problem when uploaded onto Turnitin. Turnitin might filter all the tables, proved theorems, images, drawing and formulae, equations, and graphs (Halgamuge, 2017; Oghigian et al., 2016; Rogerson & McCarthy, 2017). This is where ideological-ware comes in, which requires lecturers to exercise their creative thinking in examining Turnitin similarities (Supardi, Suhendri, & Rosdiana, 2015). Lecturers should have professional knowledge of dealing with Turnitin in mathematics, in order to understand when to take a professional, private, or public decision.

Moreover, the content of mathematics is not the same as other subjects like languages. The content of mathematics consists of algebra, geometry and trigonometry, involving measurements, theorems, equations, formulae, numbers, symbols, data handling, tables, graphs, terminology and statistics (Chogo, Githua, & Changeiywo, 2017; Craig, 2007; Khoza, 2018; Schubotz, Teschke,

Stange, Meuschke, & Gipp, 2019; Şimşek & Boz, 2016). In addition, content of mathematics is classified into geometry, algebra, and trigonometry (Khoza, 2018). According to Chogo et al. (2017), in geometry, there are a number of difficulties which are different in nature from those of trigonometry and algebra, and geometry is abstract in nature. Since, geometry is abstract in nature, it requires professional understanding. Lecturers have to read more studies on geometry, and attend formal professional development programmes (Bansilal, Brijlall, & Mkhwanazi, 2014; Khoza, 2015b, 2018). Furthermore, algebra is centred on private understanding. An individual comes with an understanding of numbers and calculations from everyday knowledge (Hoadley & Jansen, 2013; Khoza & Biyela, 2019). On the other hand, trigonometry concepts are better achieved when applied in real life and shared with others (Dündar, 2015), indicating public understanding. However, Sutherland-Smith and Carr (2005) argue that Turnitin is unable to recognise commonalities of mathematics content: it always shows strong similarities. Therefore, utilisation of Turnitin does not work in mathematics; lecturers' understanding is needed in the assessment of mathematics. Likewise, lecturers need the correct procedures for utilising Turnitin.

In addition, Hoadley and Jansen (2013) state that there are three procedures in utilising Turnitin, namely: product, process, and interactive, as well critical procedures. The authors further point out that product procedures follow the policy and include appropriate penalties that are applied (Hoadley & Jansen, 2013), demonstrating professional understanding. Process procedures detect and address the problem through introduction of academic writing skills courses (Anney & Mosha, 2015), indicating private understanding. Interactive procedures occur when lecturers detect and understand how political empowerment within the community affects and shapes students' writing (Hoadley & Jansen, 2013; Kehdinga, 2014a). Lecturers do not need to apply the same procedures to assess work by different students; they need to formulate different methods for diverse situations (Orim, 2017). In other words, lecturers can influence the improvement of writing skills by adjusting and changing detection procedures to suit the individual student (Appiah, 2018). However, these procedures are driven by lecturers' roles in Turnitin utilisation.

A lecturer's role comes into play in the use of Turnitin as instructor, facilitator, and a researcher (Ayon, 2017; Bathmaker & Avis, 2005; Glendinning, 2014; Obara, Nie, & Simmons, 2018; van den Akker et al., 2009). Sarwar, Moin, and Jabeen (2016) state that the role of the instructor is to

check the originality of work, indicating professional understanding. Obara et al. (2018) add that the facilitator should help develop students' abilities to use Turnitin, demonstrating private understanding. A case study conducted by Snowball, Silvey, and Do (2015) contributed to the literature, indicating that lecturers should play the role of the researcher, in achieving ongoing personal, academic, and professional growth, pursuing their studies and research into the utilisation of Turnitin (Glendinning, 2014), indicating public understanding. Lecturers are in the situation of finding their identity first, in order to choose whether to follow public or professional understanding in assessing students' work (Cahillane, Smy, & MacLean, 2016). As a result, finding identity calls for the reading of more literature to support the decisions made, grounded on professional evidence (Farrelly, Raftery, & Harding, 2018) in utilising Turnitin. Additionally, the study of Ward (2016) reveals that lecturers are free to utilise Turnitin at any place inside or outside the university environment, whereas time is not distributed enough across domains. In agreement with Ward (2015), a study focused on the outputs of a focus group examining the perceived users, enablers, and barriers to utilising an effective teaching environment amongst a small group of postgraduate teachers (Ryan & Risquez, 2018). The outcome of this study indicates that lecturers might use inside and outside environments at different times, implementing a blended environment. It was further revealed in the study that the delivery for a blended environment promotes flexible access to, and coordinating of part-time students. An indoor environment indicates professional understanding. In addition, the findings from the study of Oluikpe (2013), using the software Turnitin to scan for plagiarism, indicates the level of student assignments in common. Findings from the study indicate that, in the university environment, lecturers and Turnitin experts highlight plagiarism issues, indicating professional understanding. Furthermore, lecturers create the environment that helps them to understand utilisation of Turnitin (Khoza, 2016). For example, lecturers might choose to utilise Turnitin either inside or outside of the university, or blend environments creatively (Rohmad & Wahyuni, 2018), demonstrating professional, private, and public understanding. However, the study of Chew et al. (2015), as well as that of Liu and Taylor (2014), argue that a face-to-face environment is always in demand, to deal with the requirements of future education. This implies that lecturers should always develop themselves through relevant training, to promote integration of Turnitin in mathematics (Petty, Thomson, & Stew, 2012). Therefore, these components indicate the theory of Mishra and Koehler (2006), which is TPACK. Lecturers require a specific kind of knowledge − technological,

pedagogical, and content knowledge (TPACK). As a result, TPACK knowledge may enable lecturers to better understand effective utilisation of Turnitin (Mishra & Koehler, 2009). Therefore, the study adopted the TPACK as a theoretical framework to map out the concepts of the study.

1.6 Statement of the Problem

A case study on lecturers' understanding of Turnitin utilisation has not been adequately explored. Previous studies carried out reveal that perception of Turnitin has been conducted on pre-service and in-service teachers only. There is a gap between the utilisation of Turnitin in mathematics and what lecturers are actually using. Instead of utilising Turnitin, lecturers are using manual detection. This indicates that there is a lack of integration between content and pedagogical knowledge on technological knowledge. The UKZN plagiarism policy enforces detection of plagiarism, but does not specify the particular software to be utilised; and is also not specific on how to detect plagiarism in a particular subject such as mathematics. The goal of this research is to provide universities, lecturers, and schools in the South African educational sector a better understanding on Turnitin utilisation, in the context of assessment in mathematics (Ukpebor & Ogbebor, 2013). It is against this background that this present study has been carried out on lecturers' understanding of Turnitin utilisation at a university in South Africa.

1.7 Research Purpose of the Study

The ultimate purpose of this study was to explore lecturers' understanding of Turnitin utilisation at a specific South African university. The objectives of the study are:

To explore lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university.

- To understand how lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university. Remove this colour
- To understand the reason for the lecturers' understanding of Turnitin in assessing per Turnitin at a South African university in particular ways.

These objectives were important to fulfil the aims of this study, in order to answer the questions as follows.

1.8 Research Questions

- What is lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university?

- How do lecturers understand utilisation of Turnitin in assessing mathematics at a South African university?
- Why do lecturers understand utilisation of Turnitin in assessing mathematics in particular ways at a South African university?

The research questions contributed to guiding each chapter in this study, and also contributed to selecting an appropriate research design and method in addressing the aims and objectives of this study.

1.9 Location of the Study

The research was carried out in one of the schools of education at the South African University of KwaZulu-Natal. This university came about through the merger of the former universities. The university was established in the 1960s as the University College for Indians. In the 1960s, student enrolment at this institution was low. In the 1980s, owing to transformation, student numbers grew rapidly. In 1971, the college was granted university status. The following year, this university moved into its modern campus and was a site of major anti-apartheid struggle. The university became an autonomous institution in 1984, opening up to students of all races. This university was granted independent status, owing to its rapid growth in numbers, its wide range of courses, and its achievements in and opportunities for research. In 1946, the government approved a faculty of agriculture in another city and, in 1947, a medical school for African, Indian and Coloured students. In 2004, the two KwaZulu-Natal universities were among the first batch of South African institutions to merge. The mergers of universities ushered in a radical reconstruction of the national higher education system. It brings to this landscape the opportunity to build a university that is truly South African and truly global. This is an opportunity to shape an institution that represents both the richness of our heritage and the imagination of a free, democratic South Africa.

1.10 The Significance of the Study

Recognising the potential gap between the implementation of content knowledge and pedagogical knowledge with technological knowledge in assessing mathematics, there is a need for a study to explore the utilisation of Turnitin in higher education institutions. The findings of the study suggest the need for integrating Turnitin use and manual detection in mathematics. This shift requires lecturers to efficiently integrate technology with their existing pedagogical content knowledge

(Garrett, 2014). The results of this study could assist lecturers, especially those who teach mathematics, to reflect on their current practices, and perhaps on the level of support provided to students within universities on utilisation of Turnitin. In addition, the findings could help policy developers, higher education institutions, and researchers design plagiarism policies specific to each subject, benefiting the university, lecturers, as well as students. This study could also benefit the Department of Education and teachers at school level to familiarise learners with Turnitin for detecting plagiarism, also as an assessment software tool, to prepare them for higher education.

1.11 Research Methodology

This research is embedded within the qualitative research. This approach is used to find the meaning of the phenomenon from the view of the researcher (Creswell, 2013). The study implemented qualitative research to explore lecturers' understanding of Turnitin utilisation in assessing mathematics at a university of South Africa. According to McMillan and Schumacher (2010), a qualitative approach assists the researcher to understand participants' points of view. Using a qualitative approach, I was able to make knowledge statements based on the multiple meaning of individual understandings. I also attempted to draw conclusions from the data that reflected the interpretation of reality by participants (Wahyuni, 2012)

1.11.1 Research paradigm

This research is imbedded on the interpretive paradigm. An interpretive paradigm is described as an attempt which is essential in understanding the personal world of human experiences (Cohen, Manion, & Morrison, 2011a). I have therefore chosen to use the interpretive paradigm as one of the most suitable paradigms for this research, based on the belief that the truth is constructed by social actors and people's perceptions of it (Wahyuni, 2012). Via the interpretive paradigm, I was able to find the participants' understanding of Turnitin utilisation. Snape and Spencer (2003) state that reality is only knowable through the human mind. Therefore, I chose this paradigm in order to explore lecturers' understanding of Turnitin utilisation; and it draws data from lecturers' personal understanding. In this paradigm, as a researcher, I was realistic. I applied the real-world situations as they unfolded naturally (Tuli, 2010). In this study, I was guided by the interpretive paradigm to discover the different understanding of lecturers, and their experiences from their points of views (Ritchie, Lewis, Nicholls, & Ormston, 2013). Interpretivist researchers believe that knowledge is personal, subjective, and unique (Cohen, Manion, & Morrison, 2011b). As a result,

this case study facilitated a deep exploration of a real-life contemporary phenomenon in its natural context (Woodside 2010; Yin 2012).

1.11.2 Research approach

A case study is a design of an examination found in many fields, especially in evaluation, in which the researcher develops an in-depth analysis of a case (Creswell, 2013). McMillan and Schumacher (2014) emphasise that a case study examines a case, over time, and in-depth, using multiple sources of data found in a setting. For this reason, it is important that the case study be applied for the intention of this research to be achieved. To attain the aim of this research as researcher, I carefully planned the case study to give strong means of exploring situations, concerning doubts of lecturers in terms of understanding the usage of Turnitin (Gray, 2013). A case study has its own weaknesses. It is not easily open to cross-checking, hence it may be selective, biased, personal, and subjective (Cohen et al., 2011b). To mitigate the above-mentioned weaknesses, I treated all the lecturers equally; I did not interfere in the research. I allowed verification to all participants during the research and kept my personal issues to myself. The following section presents the sampling.

1.11.3 Sampling

Sampling is about making a choice in terms of choosing the relevant individuals, locations, occasions, or behaviour witnessed (Cohen et al., 2011). Skowronek and Duerr (2009)) reveal that sampling is often used to gain insight into a variety of issues related to customers: satisfaction, institute use, and user needs. In qualitative research, it is more likely that the sample size be small; this might also be caused by cost, which involves time, money, stress, and administrative support of the research (Cohen et al., 2011a). In this research I used purposive and convenience sampling. Bertram and Christiansen (2014) state that the word purposive indicates the selection of individual group for a specific aim. According to Cohen et al. (2011b), convenience sampling is about selecting the individuals who are close to the researcher to serve as participants; those who are easily reachable and available most of the time. In this study, all ten lecturers in the mathematics department were selected from the university. KZN university was purposively sampled for the study, but only four participants were conveniently accessible and available to form the sample for this study. These lecturers were selected voluntarily to participate in this case study, with the aim of divulging their understanding of Turnitin utilisation. This sampling allowed me to limit stress, time, and cost of administration (Cohen et al., 2011b). Conversely, one of the drawbacks of

convenience sampling is that it is subjected to bias, because it does not give assurance that all legitimate members have an equal chance of being included in a sample (Skowronek & Duerr, 2009). In overcoming this drawback, I chose ten eligible lecturers who were teaching mathematics at a South African university. Unfortunately, only female participants agreed to participate in this study. Furthermore, the study used the following techniques in generating data, namely: reflective activity, one-on-one semi-structured interviews, and document analysis.

1.11.4 Data generation

Data generation depends on the fitness purpose of the study (Cohen et al., 2011a). The chosen methods for data gathering should match with research questions so that the best data for answering the questions are gathered and analysed (McMillan & Schumacher, 2010). The methods that were chosen matched with the research questions as well as for answering the questions which were reflective activity semi-structured interviews (face-to-face interviews), and document analysis. These methods were used to gather the best data, and for data analysis.

1.11.4.1 Reflective activity

This research is phrased within reflective activity as an initial approach, to generate data from lecturers. Reflection is defined as an activity in which an experience is recalled (Martins, Coimbra, Pinto, & Serradas, 2015**)**. Luttenberg, Oolbekkink-Marchand, and Meijer (2018) postulate that there are four categories of reflection, namely, scientific, technical, artistic, and moral. This study pays attention on the scientific, technical, an artistic reflection. Coldron and Smith (1999) state that these reflections are about finding answers to questions like 'what is true?' (scientific reflection), 'what is effective and efficient?' (technical reflection), and 'what is good? (artistic reflection)'. These questions relate to different content. For example, scientific reflection is about generalisable insights that are the result of scientific research activities (Luttenberg et al., 2018). Scientific knowledge is motivated by frustrations of lecturers in their attempt to gain more effective control (Mortari, 2015). This form of understanding is also known as reflection-on-action, which takes place after the task is completed, in order to enlighten future behaviour (Gray & Coombs, 2018). Technical reflection is concerned with the efficiency and effectiveness of the means to achieve unproblematised ends (van Mannen, 1991 ; Zhu, 2011), as well as thinking about what lecturers actually do in practice (technical rationality) (van Mannen, 1991 ; Zhu, 2011)

indicating private understanding. This understanding takes place in the context itself, and works as a self-correction tool, tending to focus interactively on the action, its outcomes, and the intuitive knowledge implicit therein (Martins et al., 2015). Furthermore, artistic reflection is about the personal significance of the teacher in a real situation of his or her practice; for example, in everyday classroom interaction (Luttenberg et al., 2018). On the other hand, moral reflection is about general values that apply equally to everyone in every situation (Luttenberg et al., 2018), indicating public understanding. In this study, a reflective activity was conducted once; this was handed to four participants for the duration of one month prior to the semi-structured interviews. This activity tool outlined the main themes of TPACK, which are the theoretical framework of the study. The participants were requested to answer the questions framed on TPACK using the reflective tool. This process of data collection was received after two months through email, and handed in before the interviews were conducted.

1.11.4.2 Semi-structured interviews (one-on-one interviews)

Interviews are divided into structured, semi-structured and unstructured interviews (Cohen et al., 2011b). However, this research was driven by individual semi-structured interviews, since the questions were asked per the personal identity of the researcher (Chetty & Ramrathan, 2017). According to Aruwa (2011), the purpose of one-on-one semi-structured interviews is to gain access to the participants' minds; and to encourage them to describe their assessment utilising Turnitin that shapes students' learning toward the modules. Therefore, face-to-face semi-structured interviews were conducted with the four chosen participants from the ten lecturers who are teaching mathematics. The average time of each interviews was one hour. The shortest interview took one hour, and the longest interview lasted for one hour 40 minutes. All one-on-one semi-structured interviews were recorded and transcribed using the audio recorder, with the permission of the participants. The lecturers were interviewed using the same questions that are framed on TPACK concepts, answering questions like what, how, why and who, to gain more information of what, how, why, and who. In addition, individual semi-structured interviews gave the researcher an opportunity of using a list of prearranged themes, and the wording of the questions (Cohen et al., 2011a; Wahyuni, 2012). However, one of the shortcomings of the semi-structured interviews is that the researcher, during the interviews, may display favouritism and values, as well as being

judgmental (Cohen et al., 2011a). To deal with this problem during the interviews, I strove not to discriminate, as well as avoiding being judgmental.

1.11.4.3 Document analysis

Document analysis is defined as a primary data source, being authenticated in the phenomenon under study as a record of process. Such records may take many different forms (Cohen et al., 2011b). McMillan and Schumacher (2014) further argue that documents present a record of process; such as laws, policy reports, research reports/projects/assignment/theses, official publications, textbooks, and many more. In this research, the document analysis was based on the university policies and laws based on the utilisation of Turnitin. Documents were analysed with the aim of identifying and defining university laws and policies in terms of Turnitin utilisation (Mishra et al., 2010), while obtaining first-hand information, as a primary source of data (Budden, 2017). The plagiarism policy document was compared with the literature review, and recorded on the researcher's notepad, However, one of the drawbacks of document analysis is that documents do not speak for themselves; they require careful analysis and interpretation (McMillan & Schumacher, 2014). In addressing this issue, I carefully analysed and interpreted the university plagiarism policy and a Turnitin training manual used by librarians when conducting Turnitin workshops, comparing it with other studies conducted on Turnitin utilisation. The data generated from reflective activity, one-on-one semi-structured interviews, and document analysis, led the researcher to data analysis.

1.11.4.4 Data analysis

According to Chetty and Ramrathan (2017), data analysis could be produced by content analysis, and discourse analyses. Data analysis is mainly an inductive procedure of organising information into categories and identifying patterns and relationships amongst those categories (McMillan & Schumacher, 2014). In this qualitative research, data analysis started during the data-gathering process (Cohen et al., 2011a). Furthermore, since this study adopted a case study, I looked for redundancy in what we communicated after I had gained a complete understanding of what I had examined and recorded (McMillan & Schumacher, 2010). Data analysis also involves making meaning of data from the participants' exact words (Wahyuni, 2012). Thus, I drew the conclusion of the study by using the data generated from reflected activity, face-to-face semi-structured

interviews, as well as document analysis. This process started from the day I examined reflective activity document analysis and semi-structured interviews. I analysed the data in order to gain the participants' understanding of Turnitin utilisation by means of critical thinking and interpretations. I tried to make meaning by using quotations, in order to maintain the meaning of the information gathered.

In addition, I read notes and listened to the voice recorder repeatedly, in order to organise the information into categories, identifying patterns and relationships. Then I transcribed, and read the data several times, to avoid losing the information and misrepresenting the meaning of the information gathered from reflective activity, individual semi-structured interviews, and document analysis. I identified similarities and differences from document analysis, semi-structured observations, and semi-structured interviews about lecturers' understanding of Turnitin utilisation. The study used the concepts of the TPACK in which categories were developed beforehand, following guided analysis and categories modified through interaction with the information (Dhunpath & Samuel, 2009). In this case, I coded procedures by allocating the information generated from reflective activity, individual semi-structured interviews, and document analysis. Lastly, the data generated from reflective activity, one-on-one semi-structured interviews, and document analysis was captured on a Word document and kept safe (Chetty & Ramrathan, 2017). However, Cohen et al. (2011b) state that qualities of the researcher, such as understanding of the field being studied and experiences in the research, can influence the data-analysis process. Avoiding the interference in the study, I used quotations from the data generated, going back to the participants for verification of the findings before I wrote the conclusion. The data analyses gathered from reflective activity, face-to-face semi-structured interviews and document analysis ensured trustworthiness.

1.11. 5 Trustworthiness

In qualitative research the following concepts are used for issues of trustworthiness, namely: credibility, dependability, transferability, and confirmability, to ensure the quality of the study (Cohen et al., 2011b).

1.11.5.1 Credibility

Credibility is an organised process in that the reviewer writes an analysis after carefully studying the documentation provided by the research (Creswell & Miller, 2000). I engaged multiple methods, such as reflective activity, face-to-face semi-structured interviews, document analysis, as well as recordings that led to more valid, and credible construction of realities (Golafshani, 2003). I used the same questions for reflective activity, individual semi-structured interviews, and document analysis, to ensure credibility. In this way, I generated the results that are believable from the participants' viewpoint. However, one of the shortcomings in establishing credibility is the researcher's personal worldview and individual biases that may influence the study. I was aware of this factor, and guarded myself against interposing bias within the research (Kolb, 2012).

1.11.5.2 Dependability

Trustworthiness is any effort to increase **dependability.** This involves consensus and conformity in the analysis of the data, which is usually at the expense of the meaningfulness of the findings (Rolfe, 2004). Dependability also agrees with the idea of trustworthiness which promotes repeatability (Wahyuni, 2012). I achieved dependability by presenting a full explanation of the research process undertaken during data gathering, as well as providing the main methods used to gather empirical data. For example, there was a list of questions that I used during the data gathering. The evidence obtained from the reflective activity, individual semi-structured interviews, and document analysis, confirmed dependability. The study employed the same questions framed around the concepts of TPACK for the above-mentioned methods. The used of reflective activity, individual semi-structured interviews, document analysis, as well as recordings via cell phone, and direct quotations, led to extra credible, trustworthy, and diverse creation of realities (Golafshani, 2003). Moreover, I used qualitative research in this study to ensure accuracy that described the findings of the phenomena being researched (Cohen et al., 2011a). I listened to the recording repeatedly and wrote the information accurately in describing lecturers' understanding of Turnitin utilisation. Furthermore, after each transcription, I went back to the participants for cross-checking and verification, before writing the outcomes, as well as the discoveries of the research. I did that with the purpose of having the same understanding of concepts as the participants, to ensure dependability. In that respect, I avoided bias, by using the quotations of the participants to provide the empirical evidence. The cross-checking and verification before offering the outcomes and conclusions of the research, ensured transferability.

1.11.5.3 Transferability

Transferability is the level of applicability to other settings or situations. (Wahyuni, 2012) In this study, a rich and thick description was generated from the participants by means of reflective activity, face-to-face semi-structured interviews, as well as document analysis, recordings per cell phone and direct quotations. This allowed individuals to evaluate the conclusions drawn which could be transferable to another setting (Pandey & Patnaik, 2014). As stated, I listened to the recording repeatedly, and wrote the information as it was given, in order to accurately describe lecturers' understanding of Turnitin utilisation. Furthermore, after each transcription, I went back to the participants for cross-checking and verification before writing the outcomes as well as conclusions of the research, to ensure confirmability.

1.11.5.4 Confirmability

Confirmability refers to the extent to which others can confirm the findings in order to check that the results reflect the understandings and experiences from observed participants, rather than the simply giving the researcher's own preferences (Wahyuni, 2012). Therefore, the data gathered within reflective activity, face-to-face semi-structured interviews, as well as document analysis was verified by the participants to check that the data was correct (Cohen et al., 2011a). Documentation on data and progress of research was carefully kept in the form of research memos and temporary summaries as parts of the research work-book. The study acquired valid and credible multiple and diverse realities, multiple methods of gathering data. However, providing false information might affect the accuracy of this study. In dealing with this issue, I clearly explained the purpose of the research, confirmed by using the data gathered within reflective activity, face-to-face semi-structured interviews, as well as document analysis that ensured accuracy.

1.12 Ethical Issues

McMillan and Schumacher (2010) state that researchers must adopt ethical principles, which include policies regarding informed consent, confidentiality, anonymity, privacy, and caring. Cohen et al. (2011a) stress the importance of considering the results of the study gathered from the participants from the side of the researcher, and taking actions that maintain participants' self-

respect. Therefore, this study followed ethical principles to avoid any questionable ethical issues that might arise. Permission was requested by application for ethical clearance and permission requested of the gatekeeper to the university to conduct the study in the selected department. The university letter was also written to request permission for access to the university facilities. On gaining approval for the research, I contacted the participants in person and in writing, asking them to participate in the research study. On reaching agreement with the participants, I updated them verbally, and in writing about the whole process of the research, confirming their protection against any harm from the research. I also explained verbally and in writing the intention of the research study, assuring that the data generated was only to be used for the purpose of the study. Moreover, I updated all the participants on the duration of the study, their rights to confidentiality, and anonymity, and on their right to withdraw from and to re-join the study at any time. To ensure privacy, I used pseudonyms instead of real names. After being satisfied that the participants were clear about the whole process, the consent forms were signed by those participants who were willing to participate in this study. In addition, during the process of the study, I checked whether the participants were willing to continue the research. In that case, the above-mentioned ethical principles limited the ethical problems.

1.13 Limitations of the Study

There are a number of factors that affected the study, as Marshall and Rossman (1999) argue that no proposed research is without limitations. Real-world events take their own natural course and may alternatively present unpredicted resistances and limitations (Yin, 2011). In a case study, data is time-consuming to gather, and even more time-consuming to analyse (Hodkinson & Hodkinson, 2001). In light of the above studies, I was aware that, during the research process, I might encounter unforeseen restrictions. For example, the fact that I am not a lecturer at that particular university, made it a challenge to contact lecturers within the selected university; and in most cases, lecturers are extremely busy. To overcome this challenge, I was patient with my participants until they found some time. Furthermore, participants entered the field of the study with all the information about the study; and they were able to withdraw during the process of data generation. To deal with this issue, I ensured that I had more participants than the required number to participate in the study, to avoid disappointment. Above all, for this study to be successful, perseverance was vital, since this study depended on the voluntary cooperation of participants.

1.14 Theoretical Framework

The theoretical framework for the study was informed by the concepts of technological pedagogical, and content knowledge (TPACK), consisting of technology, pedagogy, and content knowledge. These concepts of TPACK strengthened my understanding in planning this study (Grant & Osanloo, 2014). This study explored the lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university. Therefore, TPACK was suitable for this study: lecturers need to have knowledge of technology, pedagogy, and content in order to utilise Turnitin effectively. Several studies have made attempts to build on Shulman's (1987, 1986) theoretical framework TPCK, now known as technology, pedagogy, and content (TPACK) (Alrwaished, Alkandari, & Alhashem, 2017; Bibi & Khan, 2017; Chai, Koh, & Tsai, 2013; Koehler & Mishra, 2009; Koehler, Mishra, & Cain, 2013; Pamuk, 2012). These researchers challenged Shulman's framework saying that pedagogical and content knowledge (PCK) are curriculum issues; that the knowledge is not complete without technological knowledge. Technological knowledge was then added as a primary component of the work of Shulman (Mishra & Koehler, 2009; Tzu-Chiang, Chin-Chung, Ching, & Min-Hsien, 2013), hence this model is known as TPACK (Koehler et al., 2013). In this model there are three components of teacher knowledge, which are technology, pedagogy, and content (TPCK) (Koehler et al., 2013). This TPCK contains three core knowledge sources, namely, technological knowledge (TK), knowledge of technology tools; pedagogical knowledge (PK), knowledge of teaching methods; and content knowledge (CK), knowledge of subject matter (Koehler & Mishra, 2009), which is discussed in detail in Chapter 3. In addition, Stoltenkamp and Kabaka (2014) further unpack the above-mentioned sources as follows: pedagogical content knowledge (PCK); technological pedagogical knowledge (TPK); technological content knowledge (TCK); and technological, pedagogical and content knowledge (TPACK).

Moreover, various studies have explored the model of pedagogical content knowledge (PCK). For example, Chai et al. (2013), defines PCK as a form of professional knowledge that lecturers possess in making the content knowledge accessible to the students through some pedagogical methods. Such pedagogical methods should be the first priority to be developed in TPACK. This PCK development is the notion of the information of the subject matter for teaching, which covers

the core business of assessment and reporting, promoting the link between curriculum, assessment, and pedagogy, taking the professional understanding curve (Koehler & Mishra, 2009). Thus professional understanding allows lecturers to examine the report of student work per Turnitin, since Turnitin is part of assessment. Assessment becomes a strong link between PCK and classroom practice, that allows lecturers to use different methods to deliver the content of mathematics (Alrwaished et al., 2017). This proposes the importance of pedagogical knowledge appropriate to teaching specific content in mathematics (Alrwaished et al., 2017). Therefore, it is essential to have teaching approaches that fit the content, elements of the content being arranged for better assessment. Teaching strategies incorporate appropriate conceptual representations in order to address students' difficulties and misconceptions; as well as fostering meaningful understanding of their academic writing (Öndeş & Çiltaş, 2018). However, teaching approaches integrate well with technological pedagogical knowledge (TPK).

Based on the above literature, PCK plays a significant part in teaching, which links professional knowledge possessed by lecturers. Lecturers then deliver the subject matter to students through teaching approaches that fit the content, for better assessment in mathematics. For better assessment, lecturers are required to have an awareness of how technological pedagogical knowledge (TPK) can change teaching and learning when technologies are used in particular ways (Koehler & Mishra, 2009). Initially, lecturers need to understand how to add technology into their practice (Alrwaished et al., 2017). The addition of technology into practice requires forward-looking, creative, as well as open-minded technology use, for the sake of advancing assessment and understanding (Koehler et al., 2013). This understanding might assist lecturers to connect their technological skills, utilising Turnitin for assessment to improve education (Widowati, 2019). Education improvement is the reflection of educators who apply technology and mathematics to real-world situations (Kelley & Knowles, 2016). This application is determined by technological content knowledge (TCK). TCK focuses on the technology used in the delivery of a specific subject, for instance, mathematics (Mudzimiri, 2012). In delivering subject matter, lecturers should understand the manner in which technology and content connects (Koehler, Mishra, & Yahya, 2007). The connection of technology and content might assist lecturers' understanding of using technology in assessing the content of mathematics effectively (Soomro et al., 2018). This implies the importance of mastering the technology, pedagogy, as well as content (Koehler & Mishra,

2009). Likewise, effective teaching with technology requires knowledge of how technology, pedagogy and content interact with each other meaningfully (Ersanl, 2016). The interaction of technology, pedagogy and content knowledge is important in training future teachers to be capable of teaching those born in the 21st century (Setuju et al., 2018). This preparation might empower future lecturers in the application of Turnitin in assessing mathematics content. Therefore, the TPACK framework is suitable for this research, in combination with the interpretive paradigm. This paradigm underlies all my work in this research. My acceptance of interpretivism is reflected in practices which emphasise the importance of understanding lecturers' viewpoints in the context of the conditions and circumstances of their lives (Cohen et al., 2011).

1.15 Definition of Terms

In this section, some of the terms that are used to describe lecturers' understanding of Turnitin utilisation in assessing mathematics are defined. In this study the following terms will have the following meanings.

- **Policy statement**

  This policy is designed to guide the staff members, lecturers, as well as students. It applies an improvement and instruction strategy to detect and hinder copying. The purpose of this policy is also to reinforce the existing systems, policy procedures, rules, and regulations of the University of KwaZulu-Natal aimed at identifying, responding, as well as decreasing the incidence of copying (Vithal, 2009).

- **Plagiarism**

  There is no common definition of plagiarism. Plagiarism is defined variously by different scholars. Commonly, plagiarism is an unacceptable habit of copying people's work, making it your own, without the acknowledgement of the author.

- **Turnitin**

  Turnitin is popular software used to check text similarities from a data base. This software filter allows users to identify and exclude quotes and bibliography from the plagiarism detection-results percentage. Filters are activated so that quotes and bibliography would be

excluded (Oghigian et al., 2016). This study reveals that Turnitin is utilised to detect and punish, detect and educate, as well as to detect and share.

Lecturers' understanding of Turnitin

Understanding is about distinguishing, explaining, interpreting, and summarising the information. Understanding of information depends on an individual lecturer, and the way in which he or she see things according to his or her recognition (William & Jun, 2006). In this sense, lecturers' understanding of Turnitin utilisation differs, depending on individual understanding. An individual lecturer utilises Turnitin according to his or her own understanding; and the way the individual interprets the intended curriculum. In this study, lecturers' understanding is categorised into professional, private (personal), and public (societal) understanding.

- **Assessment**

  Assessment is one of the key components of the evaluation experience in the education curriculum (McCracken et al., 2011). Assessment is classified into summative (professional understanding), formative (private understanding), and peer assessment (public understanding). In this study, for summative assessment, lecturers used their professional understanding through manual detection to penalize students' work proved to be plagiarised, guided by the University of KwaZulu-Natal's plagiarism policy. In formative assessment, lecturers use their own understanding to detect and support students whose work is found to be copied. However, in peer assessment, lecturers shared the scripts of students similarly, for evaluation purposes. If suspected work is found plagiarised, among a group of students, one paper is marked, the mark is then divided by the number of students who found plagiarised,

- **Mathematics**

  Mathematics is a science which comprises logic, shape, quantity, and arrangement: we find mathematics everywhere and anywhere (Hom, 2013). In addition, it is a spoken and a written language, particularly used in school mathematics. Familiarity with mathematics language is a sign of understanding it (Ijeh, 2012).

- **The concept of TPACK**

  The development of the technological, pedagogical, and content knowledge framework as a teaching theory, is used in this study. In this learning theory (TPACK), there is an intersection between content knowledge, pedagogical knowledge, and technological knowledge, marked as the area in which good teaching occurred. This theory originates from the framework of Shulman (1986, 1987), named pedagogical content knowledge PCK (Mishra, Koehler, & Henderson, 2010). Mishra and Koehler (2009) revised Shulman's theory as a new theoretical framework that they called the technological, pedagogical, content knowledge (TPACK) framework (Koehler et al., 2013). According to Mishra and Koehler (2009), lecturers should not only learn the use of current teaching and learning tools, but should also learn new teaching techniques and skills as the old and current tools become outdated. These findings indicate that lecturers need to be developed so that they are capable of integrating technological, pedagogical, and content knowledge, to utilise Turnitin successfully.

- **Technological Knowledge (TK)**

  Technology is an integral part of accessing high-level competencies, often referred to as 21st century skills (Widowati, 2019). Education has been influenced by technological advancement, like other disciplines such as engineering, mathematics, trade, science, and agriculture. The findings of this study reveal that lecturers do not utilise Turnitin. This could be the result of lacking technological knowledge. This might infringe students' right to be familiar with technology, which indicates Turnitin in this study.

- **Pedagogical Knowledge (PK)**

  Pedagogical knowledge (PK) involves teachers' deep knowledge about the processes, practices, and methods of assessment, teaching techniques, classroom management, time, lesson-plan development and implementation, as well as the entire educational processes. In this study, lecturers were able to display the above-mentioned processes. The findings

reveal that lecturers were able to reflect and discuss utilisation of manual detection using methods of assessment, teaching techniques, classroom management, and time.

- **Content Knowledge (CK**)

  Content knowledge in this study involves the actual subject matter and teaching that is to be taught in mathematics. In other words, lecturers should have knowledge of geometry, algebra, as well as the trigonometry taught in mathematics. These concepts involve numbers, symbols, tables, graphs, data handling, 2D and 3D shapes, equations, formulae, and theorems. The findings indicate that lecturers are aware of the content of mathematics.

- **Pedagogical Content Knowledge (PCK)**

  PCK refers to the individual form of professional knowledge that lecturers possess in making the content knowledge accessible to the students through some pedagogical methods (Chai et al., 2013). It is essential to have teaching approaches that fit the content, reflecting how elements of the content can be arranged for better assessment. Teaching strategies incorporate appropriate conceptual representations in order to address students' difficulties and misconceptions, and foster meaningful understanding of their academic writing. It is evident from the findings that lecturers possessed the assessment approach, as they assessed students based on the content of mathematics, hence technology is lacking.

- **Technological Pedagogical Knowledge (TPK)**

  Technological pedagogical knowledge in this study refers to lecturers' understanding of how to deal with the originality of the content detected by Turnitin; for example, how lecturers read the Turnitin report, and detect plagiarism manually.

- **Technological Content Knowledge (TCK)**

  Technological content knowledge (TCK) is defined as the deep connection technology has with content knowledge. In other words, technological content knowledge focuses on the technology used in the delivery of a specific subject, say mathematics. In the case of this study, this refers to utilisation of technology in teaching mathematics content.

Consequently, teachers should show understanding of technology by looking deeply at reports flagged by Turnitin; being able to understand the content that indicates similarity, such as mathematical equations, tables, and formulae.

- **Technology Detection (TD)**

  TD is an ability to utilise technology to detect similarities in mathematics. Technology detection requires lecturers' understanding of technology and content knowledge (TCK) in mathematics.

- **Manual Detection (MD)**

  MD is the ability to use the conscious mind to assess and check plagiarism in mathematics. MD requires lecturer's understanding of content knowledge in mathematics.

- **Technological Detection Content Knowledge in Mathematics (TDCKM)**

  Technological Detection Content Knowledge in mathematics is the ability of using technology to detect similarities in mathematics. This knowledge cannot detect plagiarism because of the commonalities of numbers, symbols, terminologies, equations and graphs assessed in mathematics. TDCKM can assist lecturers to assess a large number of student papers in a short period, as revealed in the findings of the study. In other words, Turnitin utilisation can assist lecturers to assess the correctness of the content, symbolic notation, tables, numbers, theorems or graphs (Craig, 2007) in mathematics.

- **Manual Detection Content Knowledge in Mathematics (MDCKM)**

  Manual detection content knowledge in mathematics in this study indicates the ability to use manual detection to detect plagiarism. This knowledge requires lecturers' understanding of manual detection content knowledge in mathematics (MDCKM); which might vary, depending on lecturers' personal understanding. MDCKM assists lecturers to check and assess students' work.

1.16 Outline of the Study

The study title is: "Exploring lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African University". A case study covers six chapters, in which each chapter presents a different aspect contributing to the findings of the study.

1.16.1 Chapter One: Background of the Study

This chapter provides an outline of the study and the origin of the research, by describing these subtopics: context and background of the research, candidate statement, rationale of the study, literature review, statement problem, purpose of the study, location of the study, objectives of the study, together with case-study research questions, the significance of the study, research design and methodology, research approach or style, sampling, data-generation methods, data analysis, ethical clearance, trustworthiness, the restrictions of the study, and the theoretical framework. These subtopics are presented in the form of a diagram for the purpose of displaying the linkage of concepts; and to be simply comprehended by the readers.

1.16.2 Chapter Two: Literature Review

This chapter engages the literature surrounding this study subject. The view of literature is divided into two camps. The first part discusses literature based on three levels of lecturers' understanding: professional, private, and public utilisation; followed by the concepts of the curriculum as a frame for the literature. This chapter utilises literature related to the objectives of the study, aiming to answer three research questions that have been described in Chapter One.

1.16.3 Chapter 3: Theoretical Framework

This section presents the theoretical framework supporting this research. This research is embedded within technology, pedagogy, and content knowledge (TPACK). Using this theoretical framework gave me an awareness of the research paradigm, knowledge of exploring the phenomenon, as well as awareness of the theory, to the extent that I developed a new theory.

1.16.4 Chapter 4: Research Design and Methodology

This section focuses on elucidation of the research approach utilised in this research; and how the approaches are used to accomplish the research goals, and to respond to case-study queries. The section also presents the research paradigm used, which is the interpretive paradigm. The research

style employed in qualitative research is the case study. The sampling that is used is purposive and convenience sampling, and the data-generation methods are reflective activity, face-to-face semi-structured interviews, and document analysis. The matters of trustworthiness such as credibility, dependability, transferability, and confirmability are presented, as well as the limitations of the study.

1.16.5 Chapter 5: Findings of the Study

Section Five presents the results of the research. This case study focuses on exploration of lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university. The results are discussed, following the components of the TPACK framework. The components of TPACK are presented as themes. In ensuring that the data gathered from the lecturers who participated in the research is verifiable, the direct quotes of the participants were used to sustain their views.

1.16.6 Chapter 6: Discussion and Recommendations

Chapter Six presents the outline of the entire research by inspecting whether the goals and the results of the research correspond, so that the questions of the study are addressed. In this section, the results of the study are outlined. This section also contains the inferences of the results of every theme discussed in Chapter Five, and suggestions for the research are presented.

1.17 Conclusion

This section discussed the initiation, the context, and background to the research, followed by the candidate statement, rationale for the research, as well as the statement of the problem, which provided a justification for the research. This was followed by the study's aims, objectives, and research questions, which directed the study throughout. In addition, the location of the study, research methodology, ethical issues, limitations of the study, as well as the framework considerations were presented. Lastly, the outline of the study, which highlighted material covered in each chapter of this study, is presented.

CHAPTER 2: LECTURERS' UNDERSTANDING OF TURNITIN UTILISATION

2.1 Introduction

This chapter focuses on a review of existing literature on lecturers' understanding of Turnitin utilisation in higher institutions. Utilisation of Turnitin is recommended by many universities such as Tshwane University of Technology, and Australia National University, to control plagiarism (Mphahlele, Simelane, & Selepe, 2010; Silvey, Snowball, & Do, 2016). A study of Mphahlele et al. (2010) which is based on effectiveness of Turnitin conducted at Tshwane University of Technology, indicates that lecturers have had pressure applied to them for utilising Turnitin. They further state that this comes with a challenge, because not all lecturers are able to utilise Turnitin. At the same time, there is no alternative way, because copying people's work is becoming common in almost all institutions, especially in universities (Bensal, Mariflores, & Tan, 2014). It is therefore important to review literature based on lecturers' understanding of Turnitin, understanding of assessment, understanding of technology, content and pedagogical knowledge. Turnitin was developed to detect plagiarism on written papers, assignments, projects and theses. This also suggests the importance of reviewing the literature on lecturers' understanding of Turnitin utilisation. Furthermore, it is important to review the literature on the subject under exploration, the related literature giving insight into debates, contentions, policy stipulations, and discussions around the discourse or phenomenon of Turnitin utilisation by lecturers.

A literature review is defined as a study of compiled documents, which include up-to-date information from books, journal articles, media reports, policy documents, dissertations, and theses (Boote & Beile, 2005; Cohen et al., 2011a; Moodle, 2013). According to McMillan and Schumacher (2014), literature review establishes the important links between existing knowledge and the research problem being examined, which enhances the overall credibility of a new study. Literature review serves many purposes, such as clarifying the main theories, issues, terms, and significances of these for the study (Cohen et al., 2011a). Literature review serves as a foundation of the study, raising issues, showing where there are gaps in the research field. Lastly, literature assists and leads into all aspects of the research, such as the field, the particular topic, the methodology, the data analysis, and implications for future research.

Therefore, the aim of this chapter is to draw on the existing body of the international and local literature in the research field of lecturers' understanding of Turnitin utilisation in assessment (Conole & Alerizou, 2010; Nkohla, 2017). The existing body of knowledge of this chapter is based on books, journal articles, media reports, policy documents, dissertations, and theses of international and local literature review. This chapter also intends to establish the links between the existing knowledge and the research problem, which enhances the overall credibility of this study. Furthermore, findings of the study clarify the concepts, terms, and meanings, raising issues, and showing the gaps. This study begins by explaining the lecturers' understanding of Turnitin utilisation as a research phenomenon. The study then unpacks the concepts of the curriculum, utilisation of Turnitin, background policy about Turnitin, including the University of KwaZulu-Natal's plagiarism policy, which is compared with curriculum concepts, as well as Turnitin (TII) training, knowledge of technology, knowledge of the content, and knowledge of the pedagogy. The table below shows the structure of the literature review.

Table 2.1: Structure of literature review

Project Title: An Exploration of lecturers' understanding on Turnitin			
Phenomenon: Lecturers' understanding			
Focus: Turnitin utilisation			
Concepts	Propositions	Studies	Gaps
Lecturers' understanding	1. Professional understanding 2. Private understanding 3. Public understanding	Khoza (2015a; 2015b; 2016b) van den Akker et al. (2009) Schiro (2013)	Few studies conducted using case study on lecturers using Turnitin in mathematics
Plagiarism	1. Accidental plagiarist 2. Opportunist plagiarist 3. Committed plagiarist	Beasley (2004) Ayon (2017) Louw (2017)	Limited studies discussing the incorrect citing of authors
Utilisation of Turnitin	1. Detect to punish 2. Detect to educate 3. Detect to share	Batane (2010) Stoltenkamp and Kabaka (2014) Boud and Falchikov (2006); Khoza(2015b)	Turnitin is not used by all universities. Utilisation of Turnitin is not monitored
Background Policy	1. Punitive 2. Educative tool 3. Discuss policy	Razi (2017) Thompsett and Ahluwalia (2015) Graham-Matheson and Starr (2013)	Plagiarism policy does not specify in general terms how to utilise Turnitin in mathematics
Technological Knowledge	1. Education technology (ED) 2. Technology in Education(TIE) 3. Technology of Education (TOE)	Roche (2017) Khoza (2015b) Kirkwood and Price (2013)	Limited training in technology
Resources	1. Hardware 2. Software 3. Ideological-ware	Khoza (2017) Budden (2017) Khoza (2018)	Limited training on utilisation of resources
Content and activities	1. Geometry 2. Algebra 3. Trigonometry	Chongo et al. (2017) Khoza (2018) Mardiyana and Pramudya (2019)	Turnitin is not utilised in checking the content of mathematics.
Assessment	1. Summative 2. Formative 3. Peer	Kumar and Pathak (2015) Walchuk (2016) Rashid and Rashid (2018)	Lack of Turnitin utilisation for mathematics assessment
Procedures	1. Product 2. Process 3. Critical	Hoadley and Janson (2013) Anney and Mosha (2015) Orlando et al. (2018)	Lack of balance between product, process, and critical procedures
Role	1. Instructor 2. Facilitator 3. Collaborator/ researcher	Sarwar et al. (2016) Obara et al (2018) Glenddinning (2014)	Lack of integration of roles
Platform and Interval	1. Face-to-face, inside /hours 2. Outside /days 3. Blended/ weeks	Oluikpe (2013); Liu and Taylar (2014) Arora and Pany (2018); Khoza (2016b) Ryan and Risquez (2018); Rohmad and Wahyuni (2018) Chew et al. (2015); Appiah (2018)	Students have their right to access Turnitin infringed Lack of blended approach

2.2 Lecturers' Understanding of Turnitin (Phenomenon)

Lecturers can be described as professionals who help students to learn, transmitting information on, and knowledge and understanding of a topic appropriate at a particular stage of their studies (Harden, Crosby, Davis, Howie, & Struthers, 2000). Understanding is about distinguishing, explaining, interpreting, and summarising the information (Khoza, 2016b). The lecturers need to understand the information in such a way that they reflect on experiences, in order to interpret and address the tasks that are given by curriculum developers (Khoza, 2015a). Khoza (2015d) and van den Akker et al. (2009) reveal that lecturers, as curriculum implementers, are supposed to better understand utilisation of Turnitin as a deterrent that underpins the intended assessment. It is therefore important to look at the lecturers' understanding of the usage of Turnitin. Even though there are great benefits attached to Turnitin, the reality of understanding may differ from person to person (William & Jun, 2006). In accordance with this study, a quantitative study of Garba (2017), which used the survey research method, applied a questionnaire as the instrument of data collection on 150 academic staff of Bayero University, Kano. The contribution made by William and Jun (2006) indicates that understanding is how lecturers recognise things.

A case study conducted by Khoza (2015b) on teachers' reflections concluded that Turnitin is driven by disciplinary, personal, and public understanding. Teachers responded in the interview that they detect plagiarism to punish, detect to educate, or detect to share with colleagues what is suspected to have been plagiarised. This study was supported by other studies such as those by Khoza (2015a); Khoza (2015d); Khoza (2016b); van den Akker et al. (2009); and Schiro (2013), that concluded that the three categories of understanding are respectively defined as follows: First, disciplinary understanding of Turnitin utilisation places the content at the centre of the teaching and assessment environment. Second, personal understanding of Turnitin utilisation is the understanding that perceives the individual needs and interests as the most important aspects in the assessment context. Last, public understanding places societal issues and their needs at the centre of the teaching and assessment environment. In this study, discipline represents professional understanding, personal represents private understanding; both disciplinary and societal represent public understanding.

In light of these views, lecturers' understanding of Turnitin utilisation differs, depending on the individual's understanding. An individual lecturer utilises Turnitin according to his or her own understanding and the way he or she, individually, interprets the intended curriculum. If the lecturer is motivated by private understanding of Turnitin utilisation, lecturers utilise Turnitin for developing individual knowledge, skills, and values. In this case, the lecturer would decide, after carefully checking the students' reports per Turnitin, to cater for their circumstances, understanding, and needs (Hoadley & Jansen, 2012). If the lecturers are driven by professional understanding, they have to focus their understanding on scientific knowledge which is specific to the utilisation of Turnitin (Hoadley & Jansen, 2013). Furthermore, if the lecturers are dominated by public understanding, their usage of Turnitin is societally centred, because they rely on other peoples' opinions (Khoza, 2015b).

The above statement on the various categories of Turnitin utilisation indicates that understanding calls for individual creativity to produce something new, as a contribution to their field, resulting from interpretation of the new information from their experience (Khoza, 2015a). A study by Henderson, Beach, and Finkelstein (2011) was conducted, which reviews current scholarship on how to promote change in instructional practices used in undergraduate science, technology, engineering, and mathematics courses. The review was based on 191 conceptual and empirical journal articles published between 1995 and 2008. The articles indicate that interpretation of the new information requires lecturers to first understand the system, thereafter designing a strategy that is well suited, in order to develop a successful strategy for utilising Turnitin. Henderson et al. (2011) further state that lecturers need to understand their own practice and their conceptions of assessment that influence such, in order to fully embrace the utilisation of Turnitin. The lecturers' understanding must be positioned according to the individuals' needs in order to accommodate diversity. In this case, lecturers will be able to meet individuals' needs by means of balancing professional and public understandings that might determine their private understanding. This will avoid the tension that might be created between the lecturer and the students during assessment (Tyler, 2013; van den Akker et al., 2009).

This belief is supported by a recorded interview conducted by Hiatt (1994) about Ralph Tyler's reflection on life, education, learning, and his career. The interview was conducted in 1993 at St

Paul's Health Care centre in San Diego. During the interview, Tyler argues that Turnitin assists lecturers with information; lecturers have to use their knowledge (professional), and understanding (private) to solve the problem in real life. The contribution made by Tyler implies that lecturers cannot rely solely on Turnitin, but can use Turnitin to guide them professionally on a student's report. They then use own understanding to decide whether the text flagged was indeed plagiarised. Therefore, professional understanding, private understanding, and public understanding should together determine the educational vision and objectives (Khoza, 2016; van den Akker et al., 2009). Determining the educational vision and objectives calls for a clear understanding of what constitutes assessment within a particular South African university (Khoza, 2018). In order for the assessment to be effective, it must be sustainable in that teaching and assessment activities are utilised (van den Akker et al., 2009). This indicates the significance of discussing plagiarism in the next section.

2.3 Plagiarism: A Threat to Academic Integrity

The use of the ideas and words of others without the acknowledgement of the source of that information is referred to as plagiarism (Smith et al., 2007), or literary theft (Webster, 2005). A study approach of Beasley (2004) used research process automation (RPA), which focuses on automating elements of the research and writing process; and, more specifically, on the development of research work products. This approach reveals three plagiarism types. The first type is the accidental plagiarist. A person might copy somebody's work unaware that, by doing so, he or she is plagiarising or unintentionally paraphrasing, citing, or quoting incorrectly (Beasley, 2004) (professional understanding). The second type is the opportunistic plagiarist. This is a label for one who knows that it is wrong to plagiarise but does so anyway, owing to disorganization, information overload, ethical lapses, laziness, or fear (private understanding). The third type is the committed plagiarist: one who intends, with forethought, to cheat by stealing other scholars' ideas (public understanding). Plagiarists in the fourth category as identified by Clough et al. (2015), are those who cite wrong authors.

The accidental plagiarist needs to be taught how quote, cite, paraphrase; and needs effective intensive courses to improve writing skills (Ayon, 2017). This indicates the professional understanding. Furthermore, a mixed-methods study of Ayon (2017) conducted at a private

Lebanese English-speaking university, investigated the impact of Turnitin on students' plagiarism, from the perspectives of both students and instructors. This study further argues that opportunistic plagiarists take the opportunity, if aware that lecturers do not use Turnitin. Lecturers may make this known, in order to maintain a trustful relationship with students, hoping that students will refrain from plagiarising. Therefore, lecturers who adopt this type of action are supported by private understanding. An article of Louw (2017) aims first to show that plagiarism is often caused by pedagogical shortcomings, owing to the difficulty of defining plagiarism accurately. Second, the article attempts to define plagiarism anew. A questionnaire was distributed to 17 000 students and staff members at the North West University to identify the different perceptions of students and staff in defining plagiarism. The study reveals that committed plagiarists engage in plagiarism because they are under pressure from other people; therefore, they want to show them that they can get good marks. This type of plagiarism indicates public understanding.

Furthermore, a paper written by Curtis and Vardanega (2016) discusses the relative strengths and weaknesses of research designs for assessing changes in plagiarism, over time. This paper identified seven forms of plagiarism by employing cross-sectional, longitudinal, and time-lag research designs, to examine changes over time, using an identical survey from students at Western Sydney University. The seven types of plagiarism are: (a) sham paraphrasing, which is material copied precisely from manuscripts and sources acknowledged, but represented as paraphrased; (b) Illicit paraphrasing, which is material paraphrased from the text without online acknowledgement of the source; (c) Other plagiarism might be a work copied from another student's assignment, with the knowledge of the other student; (d) Verbatim copying, whereby material is copied word for word without acknowledgement of the source; (e) Recycling, a form of plagiarism occurring when the same assignment is submitted more than once for different courses; (f) Ghost writing, which happens when a submitted assignment written by another person is represented as own work. Lastly, purloining is an assignment copied from another student's assignment without that student's knowledge.

Similarly, there are studies that affirm that plagiarism might also occur as follows: word switch plagiarism, in which a plagiarist takes a sentence from the source and changes a few words without acknowledging the source. Style plagiarism involves copying another author's style of reasoning,

by taking sentence by sentence organisation of one's thoughts. Metaphor plagiarism is the type of plagiarism in which someone uses a creative style of someone else to present his ideas, without crediting the original author of the creative style. Idea plagiarism is a practice in which one takes someone's idea, or a solution proposed by another person, using it as one's own creation, without crediting the author. Plagiarism of authorship is a form of plagiarism in which a student puts his name on someone else's work (Ali, Ismail, & Cheat, 2012; Arya & Arya, 2010; Louw, 2017; Nicholls & Feal, 2009).

In addition to these forms of plagiarism, Harris (2001) identified another form of plagiarism, stating that the concept of plagiarism has grown, and does not contribute to the above-mentioned forms of plagiarism only. Harris (2001) argues that plagiarism has so many forms, including and not limited to copying, cutting and pasting, false citation, paraphrasing, and summarising without acknowledgement, and the use of third parties such as paper mills. Plagiarism also occurs where students cite authors incorrectly, for instance. Citation and referencing analysis helps to identify fake citations, referencing inconsistencies, or the use of incorrect references (Clough et al., 2015). Clough et al. (2015) and Harris (2001)'s identifications indicate public understanding, since the above-mentioned forms of plagiarism might occur globally, where different forms of plagiarism take place. Therefore, lecturers need to go beyond detection, deterrence, and punishment, and take an innovative approach to promote a culture of academic integrity (Hanbidge, Tin, & Tsang, 2018).

Plagiarism is a known problem facing higher education across the globe, and is perceived to be a growing problem (Gullifer & Tyson, 2010). This fraudulent behaviour of students in tertiary higher learning institutions and universities is of great concern today in the era of the Internet (Eret & Ok, 2014). Several research studies reported almost the same reasons for students' plagiarism: lack of awareness, laziness, lack of skills in academic writing, family responsibilities overwhelming, forgetfulness, emotional disturbances, lack of understanding, personal attitudes, and unpunished student plagiarism (Baker, Thornton, & Adams, 2008; Batane, 2010; Smith et al., 2007). Moreover, there is the availability of improved access to Internet for sophisticated student plagiarism practices in higher institutions. In Sutherland-Smith and Carr (2005) and Batane (2010), lecturers reported laziness as the most prevalent contributing factor to students' plagiarism.

They further state that lack of skills in academic writing, and some other factors attributed to plagiarism included the temptation of taking the easier route of copying and pasting information from the Internet by comparison with the long time and effort to write correctly. Another factor is unpunished students' plagiarism actions, which have encouraged students to plagiarise (Ayon, 2017). Finally, the tendency of lecturers to give the same essays and tests every year was also reported as a contributing factor to students' plagiarism (Eret & Ok, 2014).

This suggests that lecturers who do not act against the plagiarised work are driven by public and private understanding. However, a holistic institutional approach conducted by Macdonald and Carroll (2006) using case studies from three institutions, presents a checklist for identifying the absence of a holistic approach to dealing with student plagiarism. These case studies are used to illustrate possible triggers for adopting a holistic approach. The study indicates that regulations to be followed against plagiarism are not just designed to punish, but to provide the means whereby plagiarism is avoided in future. Macdonald and Carroll (2006) further state that lecturers should ensure the following elements such as detection, regulations, or punishments are constantly in play, without being dominated by any one. In other words, lecturers are able to apply their professional, private, and public understanding accordingly, without being dominated by one particular approach. The first plagiarism detection is a manual method, and the second one is using different software (Pradhan & Pradhan, 2017).

2.4 Plagiarism Software

In checking for plagiarism in students' work, by researchers and scholars alike, several techniques and software have been invented or put forward. These software and tools include iThenticate, Viper, DupliChecker, Plagiarism Checker, PlagScan, Copyleaks, Plagium, Apachelucene, SafeAssign; Paper Rater, Source code, Urkund; Plagiarisma, and Dustball, among others (Ali, Dahwa, & Snasel, 2011; Alsmadi et al., 2014; Chowdhury & Bhattacharyya, 2016; Hiremath & Otari, 2014; Jharotia, 2018; Joshi & Khanna, 2013; Naik et al., 2015; Saini et al., 2016; Singh, 2016). An overview of some of this software is presented in the next paragraph, beginning with iThenticate.

2.4.1 iThenticate

In their paper Ali, Dahwa, et al. (2011) claim that iThenticate is one of the leading providers of professional plagiarism detection, designed to be utilised by organizations rather than for individual use. It offers restrictions for individual usage. Ali, Abdulla, et al. (2011) further state that individuals allowed to utilise iThenticate software are master's and doctoral scholars. In support of this statement, Saini et al. (2016) submit that iThenticate allows lecturers to detect an individual text up to twenty thousand papers. This service is used to check students' theses, whether it contains correct citation and content; this tool is usually found in Indian universities Saini et al. (2016). iThenticate is able to check an online and offline detailed and depth checking most types of publication like documents, including, books, articles, magazines, journals, newspapers, website and PDFs (Ali et al 2011).

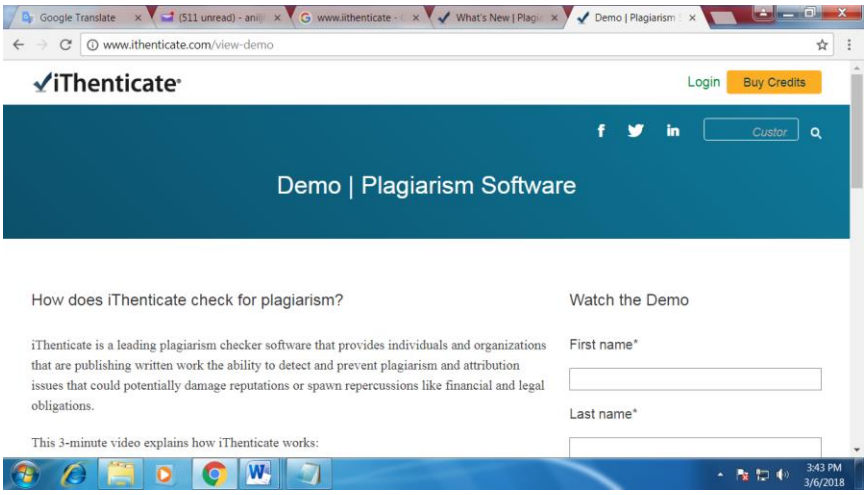


Figure 2.1: iThenticate Software (Jharotia, 2018, p. 6)

2.4.2 Viper

Viper, according to Joshi and Khanna (2013), is one of the online plagiarism tools which was developed to help lecturers and researchers. This tool takes the original document, checking it with its current database. Singh (2016) remarks that iThenticate is one of various tools adopted to detect and prevent plagiarism in articles, journals, scientific publications, and future prospectuses. The following figure shows Viper software.

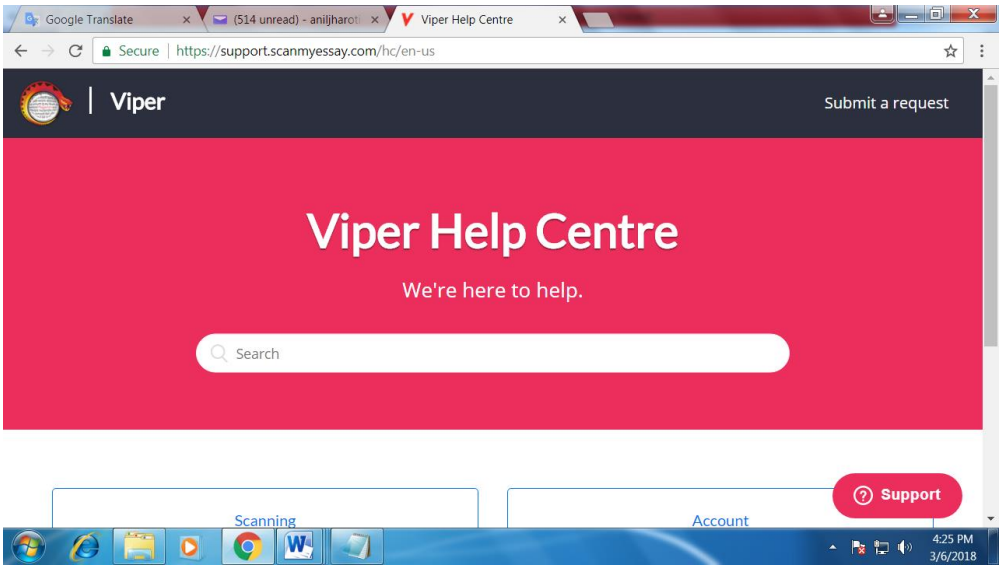


Figure 2.2: Viper Software (Jharotia, 2018, p. 8)

2.4.3 Dupli Checker

Dupli Checker is an online software that allows a lecturer to copy and paste research papers, assignments reports, theses, website content, and to click on a search button. In time, a lecturer may receive the examination report (Naik et al., 2015). According to the authors, this online software was presented in an article on an analytical perspective about plagiarism-related issues in the digital age, with special reference to Indian universities. A user of Dupli Checker might automate the process by her-or himself (Singh, 2016). Figure 3 below shows Dupli Checker.

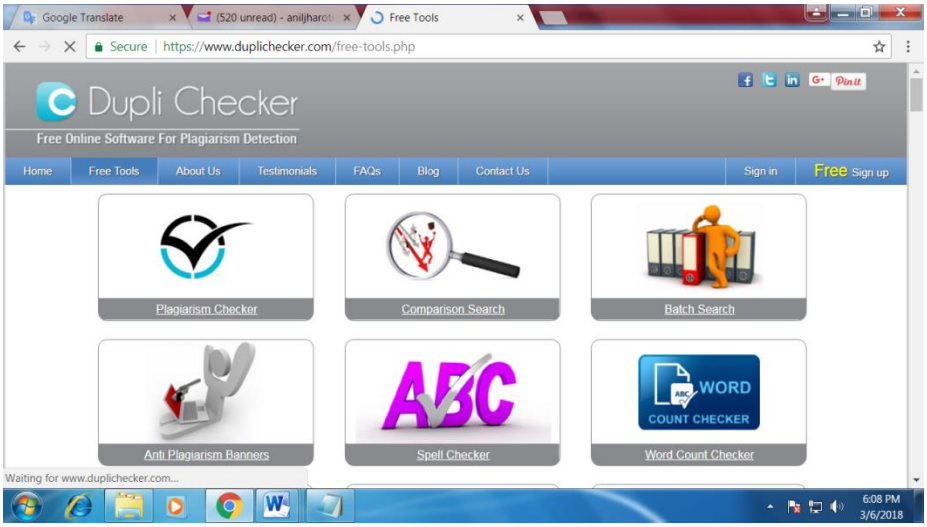


Figure 2.3: Dupli Checker Software (Jharotia, 2018, p. 8)

2.4.4 Plagiarism Checker

Plagiarism Checker is a commercial software; it is an online plagiarism software. Documents may be loaded in Ms word, HTML, and text format (Chowdhury & Bhattacharyya, 2016). The study revealed that Plagiarism Checker is one of the detection tools available for plagiarism checking and types of plagiarism. Moreover, Plagiarism Checker simply enfolds each phrase in quotation marks and inserts (Chowdhury & Bhattacharyya, 2016). In support of what Plagiarism Checker does, Puri and Mulay (2015) assert that it scans the text from the file document and shows where the plagiarism has occurred.

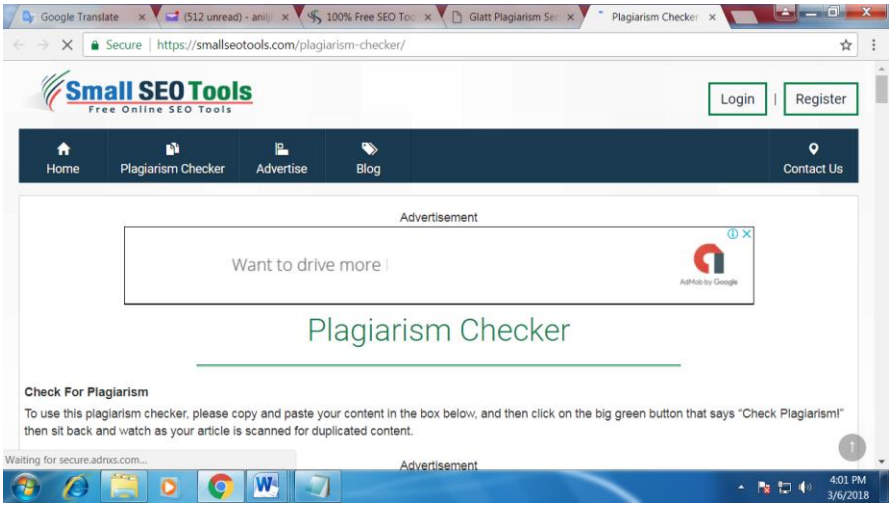


Figure 2.4: Plagiarism Checker Software (Jharotia, 2018, p. 7)

2.4.5 PlagScan

PlagScan is a type of software found online which is used for textual plagiarism checking, in most cases used by schools and universities. It offers various types of accounts with different features (Hiremath & Otari, 2014). In this software, an installation is not necessarily needed: it continuously updates the user (Saini et al., 2016). According to Chauhan (2017), this type of software helps lecturers in detecting plagiarised content. It also checks billions of web pages. Over one million research web pages are being added yearly. However, PlagScan has different packages for schools, universities, and companies; and if the user needs it, he or she must open an account and pay for it (Chowdhury & Bhattacharyya, 2016). The figure displayed below shows PlagScan.

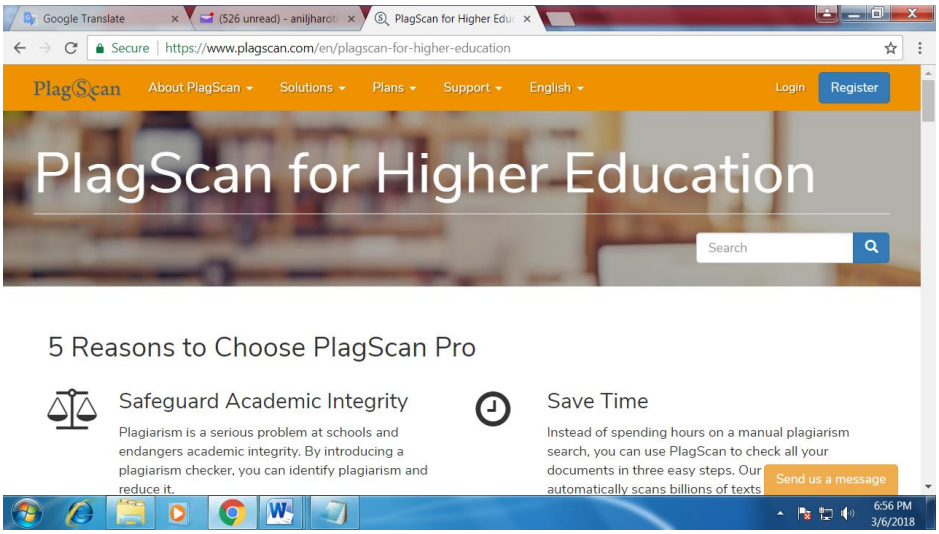


Figure 2.5: PlagScan Software (Jharotia, 2018, p. 11)

2.4.6 Plagium

Plagium as described by Nisha, Senthil, and Bakhshi (2015), is another software programme which shows the authenticity of the content available. The Plagium anti-theft detection tool is available in six languages. It is easy to use, and is also free of charge (Nisha et al., 2015). Nisha et al. (2015) further argue that, in order to inspect for plagiarised work, it is essential that the user of Plagium anti-theft programme paste content in the original portion of manuscript containing a maximum of 250 characters, before entering search. Nevertheless, Plagium is not capable of discovering slight changes in quantitative values (Baruah & Mahanta, 2018). The figure below shows the Plagium software.

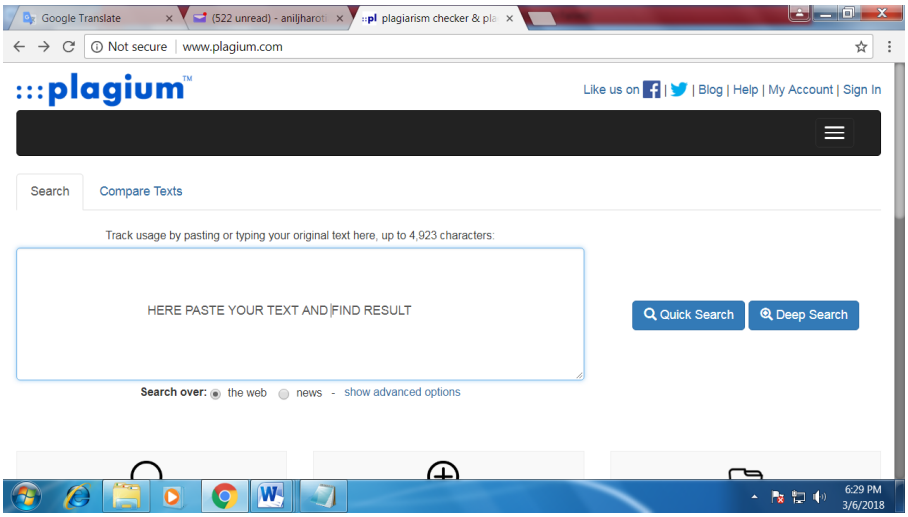


Figure 2. 6: Plagium Software (Jharotia, 2018, p. 10)

2.4.7 Urkund

Urkund is a web-based anti-plagiarism software that assists lecturers to detect and prevent plagiarism in submitted documents (Singh, 2016). Urkund software matches submitted documents against online published material from three source areas: the Internet, published materials, and previously submitted student documents (Singh, 2016). A study conducted by Singh (2016), presents an analytical perspective concerning the plagiarism-related issues in the digital age, with special reference to Indian universities. This study reveals that, from 2015-2016, almost all Indian universities moved to Urkund anti-plagiarism software, which is provided by the INFLIBNET centre.

2.4.8 Turnitin

Turnitin is the most popular text-matching tool used by public universities in South Africa (Mphahlele & McKanna, 2019). According to Yousuf, Ahmad, and Nasrullah (2012), Turnitin software was designed by 4 UC Berkeley graduate scholars, as peer review application use for their classes, which was finally developed into one of the most recognisable names in plagiarism detection. Turnitin is also used in many countries like South America, North America, Sri Lanka, United Kingdom, the United States, and India (Abrahamson & Mann, 2018; Bemmel, 2014; Pradhan & Pradhan, 2017; Ranawella & Alagaratnam, 2017; Singh, 2016). In addition, Turnitin is a software for duplicity checking for theses, dissertations, articles, and research papers (Jharotia, 2018). The figure below shows Turnitin software.

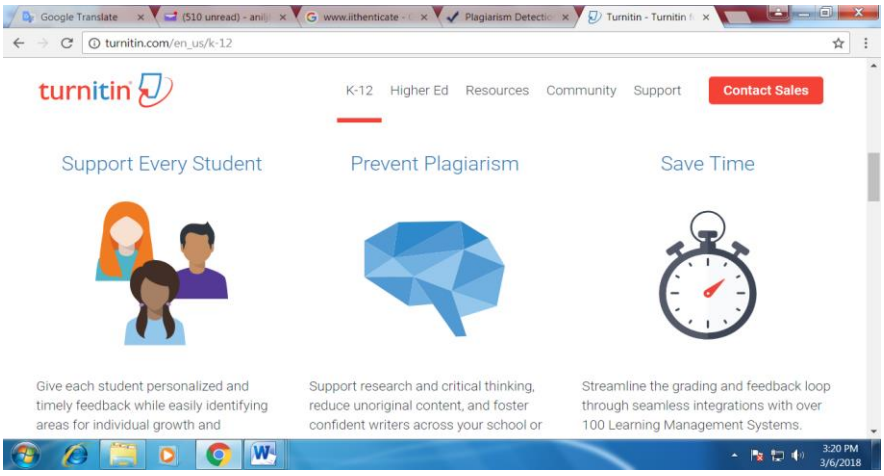


Figure 2.7: Turnitin Software (Jharotia, 2018, p. 6)

The University of KwaZulu-Natal also recommends the use of Turnitin, as it ensures that Turnitin (TII) training is provided, as conducted by Chetty (2014). Training develops the university staff. Chauhan (2017) wrote a paper throwing light on the plagiarism background, its impact, consequences, tools, and some efforts to fight plagiarism. Chauhan (2017) claims that Turnitin assists lecturers to evaluate student work. Chauhan (2017) further asserts that Turnitin is one of the best detection tools currently available. In addition, Turnitin is the most successful online software tool for identifying plagiarism, by comparing matching text of different documents on the web (Halgamuge, 2017). Turnitin is the most widely used anti-plagiarism tool used, globally. In the section designated for Turnitin, a detailed review is carried out of how this software is used, the study focusing on it. However, below are a few empirical studies on the use of other software for detecting plagiarism.

A study conducted by Joshi and Khanna (2013) used Apachelucene to detect plagiarism which first conducts indexing of the original document, and then uses cosine similarity to compare the plagiarised document with a set of documents which has previously been saved. The study indicates that Plagiarism Checker is an online tool which is commonly used in New York, offered by SmallSeOtools.Com. The lecturer simply needs to copy and paste the students' work in the given box. Furthermore, the lecturer then has to click on the button to check for plagiarism. If the pasted text becomes red this means that particular text is plagiarised Another, example of the above-mentioned software is Copyleaks which uses very advanced technology and deals with any language, including the mathematics language by Chi-Mex, Herrera, and Sánchez-Escobedo (2017). Copyleaks checks the duplicity in more than 60 trillion pages over the Internet (Jharotia, 2018). A study was conducted by Chi-Mex et al. (2017) in Mexico analysing 247 dissertations in pdf digital format, using the anti-plagiarism software SafeAssign. This study recommends that lecturers also use a common online software programme like PaperRater amongst others, to check plagiarised text, being free of charge. These authors further claim that this programme might assist lecturers in Mexican universities. The findings have shown that plagiarism and a lack of originality must be addressed in that country. There are three different parts available in the PaperRater software programme that assist in proofreading, spelling, and duplication inspection (Joshi & Khanna, 2013).

A paper written by Alsmadi et al. (2014) used source-code plagiarism detection tools to assess the level of plagiarism in source codes. In this paper, an investigation was also conducted on issues related to accuracy and challenges in detecting possible plagiarism in students' assignments. In addition, a comparative study was conducted as a preliminary experiment. This study evaluated three plagiarism detection tools, namely: Plagiarisma, Dustball, and DupliChecker. The results of the test conducted on this study reveal that Plagiarisma is the most accurate and reliable tool for detection. SafeAssign software, which is integrated with a blackboard course management system and Turnitin, is used in Virginia community universities (Hunt & Tompkins, 2014). Hunt and Tompkins (2014) further state that some lecturers in Virginia did not appreciate SafeAssign software, even though SafeAssign software is integrated at no extra cost. SafeAssign does not possess the two options of excluding quotes and bibliography, as found in Turnitin (Hunt & Tompkins, 2014).

In light of the above discussed anti-plagiarism software, various types of anti-plagiarism tools, are used, depending on the particular country or university. There have been many tools developed since the problem of plagiarism became rampant. Plagiarism is a spreading disease that might take much time to cure. It is unfortunate that, although studies have been conducted, none of them have provided successful plagiarism tools for mathematics, even though more tools are currently being developed (Hristov, 2018). For example, a study was conducted by Hristov (2018) at the University of West of England in Bristol, UK on students taking an Engineering Mathematics module. It was conducted on the frame of TeSLA (An Adaptive Trust based e-assessment System for Learning) to provide new solutions in continuous e-assessment especially in differential equation education. TeSLA is a project funded by the European Commission, aiming at the development of various instruments for students' electronic authentication and authorship, in both an online and blended learning environment. This study integrated the TeSLA face-recognition instrument to reduce cheating in the summative assessment in mathematics. The study also indicates that this new model, that is, TeSLA face-recognition software, gathers all the information from the continuous assessment in Moodle. This greatly facilitates keeping, sorting, and assessing all the materials on continuous assessment.

In other words, TeSLA face-recognition software is capable of detecting every face, using this model. A researcher or a student is compelled to have knowledge and understanding of utilising TeSLA face-recognition model. Conversely, the reason for using detection tools is not about who uploads the document. The main aim is the detection of the plagiarised work, including the owner of the uploaded text. This face-recognition software does not give assurance that a student or researcher who uploads his or her work has solved the problem him- or herself (Puri & Mulay, 2015). Another graphical analysis system was developed by Jithin et al. (2017), in which flowcharts were compared in the shape, orientation, as well as text. The aim of this approach is to detect plagiarism in flowcharts. The authors argue that flowchart-based plagiarism detection systems are rarely applied. The authors concluded by claiming that the approach is capable of detecting plagiarism in same-shape objects, even though the orientation of the graph is changed.

Universities are thus faced with huge challenges of monitoring plagiarism in mathematics throughout educational practice. This also suggests that more advanced anti-plagiarism software digital devices need to be invented, especially for mathematics. Mphahlele and McKanna (2019) recommend the application of modified concepts like performing checks on symbols, formulae, graphs used in different software. However, the focus of this study is on Turnitin, that is, lecturers' understanding of its usage. This is the official software adopted by the university of KwaZulu-Natal in checking for plagiarism. A paper was written by Baker et al. (2008), which analysed rules as well as surplus papers in connection with illegal use of other peoples' work at South African higher institutions. This paper reveals that Turnitin is the most popular software utilised in South African higher institutions, to check whether students have reproduced the work of others.

2.5 Turnitin Utilisation

Today's lecturers face the challenge of instilling honesty in students, by promoting the culture of learning rather than copying, students might learn to do things the right way, even if there are no lecturers looking at them, long after they have left the university (Dyer, 2010). Plagiarism is a problem experienced over the entire world, specifically in the 21st century (Idiegbeyan-ose, Nkiko, & Osinulu, 2016). To solve this problem, Turnitin has become a favourite tool utilised to compare the script submitted with writing from various sources (Garba, 2017). Most higher institutions have adopted Turnitin software to check various publications, ensuring that academic integrity is

maintained in education. Most of the higher institutions have adopted Turnitin software to check various publications, ensuring that academic integrity is maintained in education (Idiegbeyan-ose et al., 2016). This software, so far, is perceived as the solution that might assist in fighting the spread of plagiarism (Kostka & Ebsworth, 2019). Turnitin is trusted by many universities as a network that archives more than twenty-four billion written books, textbooks, newspapers, journals, as well as technological database theses (Garba, 2017).

The researcher Dahl (2007) investigated differences between plagiarism levels in doctoral dissertations submitted by students enrolled at traditional, brick-and-mortar institutions, and those by students attending online counterparts. The sample consisted of 368 dissertations written between 2009 and 2013 (184 from traditional institutions and 184 from online institutions), mined from the database and uploaded onto Turnitin for analysis. Findings from this study revealed that plagiarism problems led to the development of the Turnitin programme by John M. Barrie, when he was a graduate student at the University of California (Berkeley). Dr. Barrie is currently the president and CEO of iParadigms. Dr Barrie continues to provide a vision of digital intellectual-property detection in published material. In simple terms, Turnitin is an originality-checking and plagiarism-prevention service used by millions of individuals and thousands of institutions worldwide (Glod, 2006), indicating professional and private understanding. Turnitin has been used for nearly ten years to help university faculty members and administration overcome the problem of plagiarism (Sutherland-Smith and Carr (2005). In addition, Turnitin encourage proper usage of citing other people's written articles (Sutherland-Smith & Carr, 2005). Turnitin allows lecturers to check plagiarism, while it evolves into a more all-round electronic submission and grading tool (Batane, 2010). In support of Turnitin utilisation, the University of KwaZulu-Natal's contribution ensures that there are training programmes conducted to familiarise the staff members with Turnitin processes, such as the one conducted by Chetty (2014).

By the year 2006, Turnitin was being used by about 6,000 academic institutions. Some 60,000 students' assignments were uploaded into the database daily, evaluating student learning (Khoza, 2015b). This suggests the importance of Turnitin in helping lecturers become aware of issues of plagiarism. Previous studies on Turnitin concentrated much on the issues of plagiarism. Youmans (2011) conducted a study on teachers' perspectives using seven (7) selected teachers from seven

(7) faculties at the South Coast University on the effectiveness and usability of Turnitin. The study found that Turnitin helps to identify text that contains and matches other sources. However, Batane (2010) argues that they still cannot be sure whether this software really provides an accurate indicator of plagiarism. O'Hara, Carter, and Manassee (2007) also conducted a study on students at the University of Botswana, checking the plagiarism levels. The research revealed that the rate of plagiarism among students, on average, is about 20.5%. Turnitin software was introduced to the students, warning them of the issues of plagiarism. Eventually, per Turnitin usage, the plagiarism level was reduced by 4.3%. Thus, related to the previous studies, Khoza, (2015b) study focused on how Turnitin software can help students on self-assessment to be more disciplined in carrying out their duties, making proper citations. Turnitin is one of the current digital technology (DT) resources that permits lecturers to motivate students to express their own ideas, and not copy other people's work (Govender & Khoza, 2017; Ndlovu, 2017) (private understanding). Turnitin also assists in plagiarism detection (Khoza, 2016b; Schiro, 2013).

Furthermore, studies of Berkvens et al. (2014); Graham-Matheson and Starr (2013); Khoza (2015a); Khoza (2015b); Khoza (2016a) indicate that Turnitin is utilised for three reasons. It is utilised for detection and punishment (professional understanding), detection and educating (private understanding), and detection and sharing (public understanding). Scholars such as Batane (2010); Boud and Falchikov (2006); Kehdinga (2014a); Khoza (2015b); Penketh and Beaumont (2014); and Rolfe (2011) indicate that private understanding of Turnitin caters for educative purposes (detect and educate). The professional understanding of Turnitin caters for punitive purposes (detect and punish), while the public understanding of Turnitin caters for sharing purposes (detect and share). According to Buckley and Cowap (2013); Khoza (2015d), private understanding of Turnitin is supposed to dominate in the lessons taught in classes within the education system. In other words, the educational approach to using Turnitin should start by shifting the focus from catching to assessing students (Stoltenkamp & Kabaka, 2014).

Utilisation of Turnitin is driven by private, professional, and public understanding (Khoza, 2016). According to Khoza (2015b), if the understanding is driven by detecting to punish or reward, and by public opinions, this mostly addresses the understanding of professional and society understanding. If the understanding is driven by private utilisation of Turnitin, this addresses

lecturers' personal understanding, which helps the lecturers to understand professional and societal utilisation of Turnitin (MANCOSA, 2014). Personal needs are about the needs that help individual lecturers to understand and construct their own unique individual identities, which help them to choose whether they take direction from professional or public understanding during their teaching (Rolfe, 2011).

However, in South Africa, there are few studies on Turnitin conducted within the interpretive paradigm of the case-study research. The interpretive paradigm aims at interpreting lecturers' understanding, in order to improve their technological integration process (Rolfe, 2011). Technology improvement might change lecturers' understanding that providing students with access to Turnitin reports, would allow them to discover other strategies to avoid detecting plagiarism (Halgamuge, 2017). This suggests the need for a study conducted on the interpretive paradigm using case study, which will explore lecturers' understanding of Turnitin utilisation in teaching mathematics. However, various perceptions were found at the University of the Western Cape, where Razi (2015) investigated the adoption and implementation of Turnitin. The use of Turnitin was intended not only to detect plagiarism but also to help students improve their writing skills; thus, a developmental (private understanding), rather than a punitive approach (professional understanding) was followed. Using a case-study design, the researchers collected qualitative data through open-ended evaluation forms filled in by lecturers on their use of Turnitin, their attendance at training sessions, their understanding of the functions of Turnitin, and email responses exchanged between lecturers and the Turnitin support team at the university. The results show that several lecturers adopted and used Turnitin, which denied students the opportunity of plagiarism, improving their writing through the originality reports they received when they submitted their assignments on Turnitin. Another major finding was that only 70% of 38 participants fully understood the functions of Turnitin. Such poor understanding contributed to the minimal use of Turnitin. Turnitin has advantages that contribute to lecturers' understanding.

2.6 Advantages of Turnitin

Turnitin is one of the most popular software programmes of all the present plagiarism software used in academia, including in South African higher education (Halgamuge, 2017; Mphahlele & McKanna, 2019). According to Hunt and Tompkins (2014), many universities have adopted

Turnitin because they believe that Turnitin detects more plagiarism, and is more intuitively designed, giving direction which is helpful to lecturers when used in text reviewing (Oghigian et al., 2016). Text review by lecturers only would not be possible with utilising Turnitin. Turnitin is a web text that inspects any text that is submitted and stored in a web, such as massive databases of periodicals, journals, and other publications (Mphahlele & McKanna, 2019). A study was conducted by Lindoo (2013) on two forces which are driving computer science majors to accidently plagiarise written papers. It was found that the first force is the Internet, and the electronic information it provides. The second force can often be a combination of the amount of code reuse computer science instructors permit, together with computer science instructors not always explaining plagiarism; especially as it relates to non-computer science courses. This study intended to reinforce to computer science educators the importance of including a brief lecture on plagiarism at the start of each course. The findings of the study reveal that Turnitin is capable of detecting sources in student writing from legitimate educational resources, academic, and homework sites, new and portal sites, as well as encyclopaedias. In this connection, Turnitin is essentially used by universities and academic schools to check the legitimacy of the submitted script. It is also designed for teachers and students in the classroom settings (Nisha et al., 2015). Turnitin is used to detect written assessment, presentations, assignments, various projects, theses, and dissertations submitted against archived papers lodged in previous sessions, adding to the available publications, as well as online work (Nisha et al., 2015; Rogerson & McCarthy, 2017). This software tool is able to process over 60 million papers per year; and students can use Turnitin's write-check service for proper citation as well as to access various writing tools (Yousuf et al., 2012). It is highlighted that, while Turnitin identifies most academic misconduct, tutors mark submissions, and can still detect additional plagiarism (Buckley & Cowap, 2013) that might have occurred.

Based on the above literature, Turnitin software has become the educational software which is favoured in most of the universities around the world. This Turnitin software is perceived as one of the best plagiarism-detection tools, helping lecturers to evaluate student work, and provide feedback with respect to any string of words matching the reported work (Chauhan, 2017). This report underlies the similar sentences which give links to suspected sources (Vani & Gupta, 2016). The author also points out that the result of Turnitin is obtained as an entire submitted text with

plagiarised segments highlighted, giving a report. These reports clearly show where to find the similarities with the paper submitted, the percentage of each similarity, as well as exactly where the information comes from (Rogerson & McCarthy, 2017). This suggests the significance of utilising Turnitin to check and produce a Turnitin report in order to avoid cheating, copying, and modifying documents created by others, without citing the owner of the document (Sabharwal, 2016). Moreover, this was conducted with the objective of finding intricacies faced by students, research practitioners and professionals during their research; and to suggest the best software alternatives for each category of problems faced by them, based on expected characteristics. The study was conducted with the intention of helping researchers from diverse fields, especially those not belonging to information technology and its related background. This study suggested that the capability to use Turnitin effectively requires comprehensive knowledge of the application and its characteristics. Therefore, before adopting Turnitin, the researchers must take a thorough review of the extant body of literature on Turnitin, studying its functional details as well as using it for a brief period to understand it, while familiarising with its interface, in order to gain a feel for its features and user friendliness. This knowledge might have effects on changes and interventions demanding avoidance from the practice of utilising Turnitin without training (Basak, 2014). This training might provide lecturers with the knowledge that Turnitin is easy to use and does not take much time for lecturers and students to learn how to utilise Turnitin (Halgamuge, 2017).

2.7 Limitations of Turnitin

As much as Turnitin is being preferred by many universities, there are reports of limitations of Turnitin, according to the study conducted by Halgamuge (2017) investigating efficiency of Turnitin software as a formative writing tool. This inquiry examines undergraduate and postgraduate students' experiences while utilising Turnitin. The study reveals that Turnitin flags everything, including mathematical formulae. In general, this software is not intelligent enough. In mathematics, many assignments are given on the same question, which covers many mathematical formulae. This study further reveals that Turnitin is unable to recognise the formulae that should not count for matching contents. In addition, Turnitin is not capable of picking up text copied from textbooks which are not available online, as well as recognising images, graphs, and mathematical equations (Razon et al., 2017; Reporter, 2016). For example, a study of Razon et al. (2017), described individual cases where the results of Turnitin may lead to false judgment of

plagiarism or absence of plagiarism. These cases are taken from authors' experiences and those of students. The findings of the study reveal that, were it was not for the sake of the instructor who noticed the text, which seemed too good to be true, therefore locating an old textbook, the student would have got away with plagiarism. This type of investigation requires lecturers who are specially trained in finding copied work, and also who produce the proof of the copied work, before further steps are taken (Mphahlele & McKanna, 2019). Furthermore, Turnitin software displays the genuineness of the script, but does not directly state whether it is indeed plagiarised (Pulkkinen, 2017). Oghigian et al. (2016), argue that Turnitin software does not detect texts as plagiarism, nor differentiate between types of plagiarism, such as the density of highlighted text, and the number of sources from their originality.

Furthermore, Turnitin is perceived as policeman that catches thieves for wrongdoings they were not told about, to warn them and be punished (Rashid & Rashid, 2018). Reporter (2016), from the university of Ghana, following the approval of the university plagiarism policy of introducing Turnitin software to the University of Ghana, facilitated the implementation of the policy. This report reveals the following limitations of Turnitin. First, Turnitin is unable to provide a ready solution to plagiarism. Second are gaps identified in the search base of Turnitin, for example, (i) Turnitin might not be able to detect plagiarised work from textbook or sources which are not readily available on world wide web, being too old, (ii) Turnitin might not detect text which is plagiarised through translation from one language to another, and (iii) This software might not be capable of searching all electronic journals. Moreover, the findings from the study of Halgamuge (2017) reveal that Turnitin is easily manipulated by uploading images of the assignments instead of text. Besides, programmes such as Turnitin cannot distinguish between properly sourced material such as quotations, and references, and random occurrences of text (Walchuk, 2016). In addition, Turnitin is unable to distinguish between referencing styles, such as American Psychological Association (APA), Harvard style, and other styles, in checking uploaded documents (Khoza, 2015b).

Based on the above literature, it clear that Turnitin on its own might not provide accurate detection As Razon et al. (2017) state, plagiarism software such as Turnitin is simply software. Such software must be used carefully, and should not replace the judgment of a lecturer, or plain

common sense. In other words, Turnitin should not be used as a policing tool, but as pedagogical tool that might assist lecturers readily to see the strings of similar words, informing teaching and learning (Mphahlele & McKanna, 2019; Oghigian et al., 2016). This assistance of using Turnitin as a pedagogical tool can be a challenge to lecturers who have not undergone special training. Turnitin has many drawbacks, starting from how it works, to the meaning that is gathered from a Turnitin report (Mphahlele & McKanna, 2019). In other words, lecturers have to be trained to use the Turnitin software as a tool for affirming genuine writing (Ranawella & Alagaratnam, 2017). Lecturers need to be trained on Turnitin utilisation in order to take informed decisions based on the report generated by professional and private understanding. Horovitz (2008) argues that Turnitin does not determine whether a student has plagiarised. Instead, the system simply highlights for lecturers any matches found in databases, offering lecturers the sources of the matches. Lecturers must then make their own determinations regarding plagiarism, indicating private understanding. Lecturers must overcome the challenges which might otherwise significantly affect the success of plagiarism detection (Patil & Nikhil, 2016). This also suggests that this behaviour promotes students' academic writing while increasing understanding of plagiarism (Buckley & Cowap, 2013). This also suggests that lecturers should be guided by the policy in order to make a professional judgment.

2.8 Background Policy

A university policy is defined as a document that obliges all staff and students to behave according to the high standards of academic honesty in any assessment, research, and publication in which they engage (Thompsett and Ahluwalia (2015). This section discusses the University of KwaZulu-Natal (UKZN) plagiarism policy procedures (Vithal, 2009), the background which forms part of this study. It begins with an overview of the policy. The UKZN plagiarism policy and procedures were approved by Senate Council in 2009, becoming active in 2010. This policy was reviewed in 2013 and revised in 2014; it was also reviewed in 2017. The UKZN plagiarism policy and processes stated that the institution will not tolerate plagiarism within the institution, and will apply appropriate prevention and detection controls. Prevention measures will include a range of responses aimed at educating the university community regarding plagiarism (public understanding). Provision will be made for reporting of any suspected or actual instances of

plagiarism. All allegations of plagiarism will be investigated and, where appropriate, followed up by the application of all remedies available to the full extent of the law.

Similarly, the studies support the UKZN rationale, as these connect the teaching practice with the utilisation of Turnitin. In a study on education (van den Akker et al., 2009) assert that rationale is a connection of all syllabus concepts that provide consistency and coherence of a teaching practice. According to Berkvens et al. (2014)), rationale ensures successful education reform. This rationale can be categorised into three core perspectives: content, individual, and social reasons (Berkvens et al., 2014; Khoza, 2015b). According to Hiatt (1994), the rationale of a lecturer should be to develop a student to become well-educated. Therefore, the rationale in teaching and learning should connect all concepts of the curriculum; if not, the curriculum has no coherence, and it misrepresents its honesty (Berkvens et al., 2014). This study is based on the lecturers' understanding − their professional, personal, and public understanding. In support of this UKZN plagiarism policy, a study conducted by Chew et al. (2015) stated that that the quality assurance agency (QAA) has forced universities and higher education institutions to have effective measures set in place that deal with breaches in assessment regulations; most commonly dealing with offences relating to plagiarism, such as Turnitin (professional understanding). In line with this policy background, a study was conducted by Graham-Matheson and Starr (2013) on the student and staff cohort, exploring their perceptions on using Turnitin. This study reveals that most lecturers are faced with unexpected policies, and they have to undergo a challenging transition to unfamiliar academic cultures and values. In addition, one of the policies that is currently in place in most universities is the adoption of Turnitin, since plagiarism is a worldwide problem (Thompsett & Ahluwalia, 2015). In addition, prevention measures include a range of responses aimed at educating the university community regarding plagiarism (public understanding).

The University of KwaZulu-Natal's (UKZN) plagiarism policy and procedures indicates that it tolerates no plagiarism within the institution, applying appropriate prevention and detection controls. The checking of plagiarism involves outside lecturers, the software preferred by the university, as well as using other means of catching those students who steal others' work (Vithal, 2009). The policy is not specific about Turnitin utilisation for mathematics; however, the

university provides the Turnitin (TII) training programmes. These training programmes should be addressing utilisation of Turnitin in mathematics.

Furthermore, Thompsett and Ahluwalia (2015) investigated the use of Turnitin in a new university in Kent. Although the use of Turnitin for originality checking was not then obligatory, it was employed in 17 out of 23 teaching departments across the 5 faculties. Through this investigation, the researchers aimed to help establish the university's plagiarism policy; and to develop staff and student understanding of this policy, as well as the use of Turnitin in avoiding plagiarism. Using a case-study design, the researchers asked all students and staff members at the university to complete an online survey about their understanding, perceptions, and experiences of plagiarism, Turnitin software, and university policy. Some 367 students and 62 staff members completed the survey; and follow-up interviews were made with 34 participating students and 26 participating staff members. The researchers found that the staff and students supported the use of Turnitin in originality reports. The majority of them understood the plagiarism policy and the role of Turnitin in detecting plagiarism. About half of the participating students who had used Turnitin reported that the software had helped them to improve their referencing skills; a lower number of them talked about improved writing skills, in general. What is interesting about this study was the adoption of Turnitin not only as a plagiarism-detection tool, but as a teaching tool to help students avoid plagiarism (private understanding). By sharing originality reports with students and discussing with them ways of avoiding plagiarism, students were able to improve their writing in general, and referencing skills in particular (public understanding), to achieve the set goals.

Berkvens et al. (2014) argue that competence in education is couched within the principal goals and aims that guide the teacher in education, which are considered important. According to Khoza (2015c), it is the responsibility of the lecturers to reflect on what they are teaching at their institutions in order to interpret the curriculum and implement it successfully, to achieve the desired aims, objectives, and outcomes. Furthermore, aims and objectives are designed according to facilitators' needs rather than students' needs (Khoza, 2015c). On the other hand, learning outcomes focus on what some students have achieved, and what they can demonstrate at the end of learning (Kennedy et al., 2006). Berkvens et al. (2014) state that the aims and objectives can be approached from any of professional, personal (private), and societal (public) perspectives. Khoza

(2015b) states that objectives are in favour of content reasons, while aims are in favour of personal reasons. However, learning outcomes are in favour of societal reasons (Berkvens et al., 2014). Moreover, according to Khoza (2013b), objectives are formed according to implementers' purposes rather than the students' desires. Aims indicate what the lecturer wants to cover in a block of learning (Kennedy et al., 2006). However, learning outcomes insist on what students should learn, in order to perform well in society (van den Akker et al., 2009). Furthermore, teaching should prepare students to exhibit independence and initiative in directing their own learning (Hoadley & Jansen, 2013). There is a need to prepare students through Turnitin, in order to develop their academic writing.

Moreover, the university of KwaZulu-Natal's (UKZN) plagiarism policy stipulates that the goal of this policy is to set down the response of the UKZN to plagiarism, reporting on allegations of plagiarism for students in the undergraduate and postgraduate studies. The policy supports the system in place, including specified rules and regulations of the university, with the aim of exposing and minimising the habit of stealing the work of others. The above-mentioned plagiarism policy encourages the awareness of preventing plagiarism through educational programmes. It also emphasises the importance of having full details of the suspected work before taking relevant procedures (Vithal, 2009). In support of this policy, Hoadley and Jansen (2014) and Graham-Matheson and Starr (2013) state that some policies have been implemented to be punitive (professional understanding), while some take an educative and supportive stance (private understanding).

This shows that the policy covers the required goal. Specifying the awareness and educational opportunities of plagiarism should be practised (professional understanding). In this case, lecturers should achieve objectives by means of detecting to punish. The policy specifies that lecturers should detect to educate, using any device, in order to achieve the aims of Turnitin utilisation. Last, lecturers are supposed to act on and report any suspicious practise of plagiarism in which students have copied from other students, the Internet, web pages, or the library. In avoiding this act, lecturers should allow students to utilise Turnitin to prevent them from taking instructions and guidance from other people, in order to achieve the required learning outcomes (Khoza, 2015b).

According to studies of Thompsett and Ahluwalia (2015), and Chew et al. (2015), Turnitin should be utilised as a teaching aid and for improving the teaching rather than as a detective and policing tool, to create a trusting self-service teaching. Thompsett and Ahluwalia (2015), argue that the rapid rate of assessment reform within a relative short period results in some lecturers holding certain understandings about the assessment and implement which is not intended by the policy. According to the studies of Hoadley and Jansen (2012) and Schiro (2013), some policies have been implemented to be punitive (professional understanding), while some take an educative and supportive stance (private understanding). According to studies of Khoza (2015b) and Kehdinga (2014b), Turnitin should be utilised as a teaching aid. Hoadley and Jansen (2014) argue that the rapid rate of assessment reform within a relatively short period results in some lecturers holding certain understanding about the assessment and implementation which is not intended by the policy. This confusion might be at the centre of teaching (Hoadley & Jansen, 2013), lecturers seeking advice from others (public understanding). This teaching and learning is mostly influenced by opinions, general knowledge, and oral conversation (Chew et al., 2015), which indicate private and public understanding.

The changes to the curriculum, policies, and lecturers' understanding are therefore not static, but keep changing as the content of educational knowledge keeps changing (Hoadley & Jansen, 2013; Razi, 2015). In general, these changes leave contradictions and inaccuracies in lecturers' understandings and practice (Wallace & Wild, 2010) These authors further state that the changes to the assessment and its policies result in a high level of confusion amongst lecturers on what they are expected to do. This also suggests the necessity to explore the development of a Turnitin policy and pedagogical user guide for Turnitin at universities to ensure good understanding, and a consistent and standardised teaching Roche (2017). However, this depends on lecturers' understanding. It is their responsibility to make sense of the Turnitin policy, whether they utilise Turnitin for private, professional, or public understanding (Khoza, 2015d). The implementation of the intended policies with regard to Turnitin utilisation requires lecturers to understand technology.

2. 9 Technology in Mathematics: Turnitin

Technology is defined as methods, systems, and devices which are the result of scientific knowledge being used for practical purposes (Khoza, 2015d; Kirkwood & Price, 2013).

Technology, according to Khoza (2015d), is defined as the use of scientific knowledge for practical purposes or applications, whether in industry or in our everyday lives. Whenever we use our scientific knowledge to achieve some specific purpose, we are using technology. Therefore, technology, in this context, could be the ability of lecturers to carry out assessment through the use of digital tools. A study was conducted by Khoza (2013a) aimed at developing a better understanding of 125 undergraduate English as Additional Language students' academic experience at an Australian university. The study contrasted the experiences of students who had gained admission via university English Academic Purposes pathway, with explicit focus on digital literacy practices, with students who entered via an alternative pathway, without explicit digital literacy tuition. In addition, a case study was conducted by (Khoza, 2015a) on two groups of students and a facilitator, who were involved in the teaching and learning of a postgraduate research module.

A case study carried out by Khoza (2015a) on two groups of scholars and a facilitator, who were involved in the teaching and learning of a postgraduate research module, reveals that technology resources are categorised into two groups, namely, technology in education (TIE) and technology of education (TOE) resources. TIE and TOE are the agents of change, and they are the core elements of educational technology (ET) (Khoza, 2013a, 2015d). TIE is also known as hardware (HW) and software (SW), while TOE is known as ideological-ware (IW) (Budden, 2017; Czerniewicz & Brown, 2014 ; Khoza, 2012; Pather, 2017). Hardware, software, and ideological-ware are the teaching aids within mathematics lessons (Khoza, 2015b), according to a case study carried out by Khoza (2012) on one facilitator with eight students using online resources in teaching a curriculum module at one South African university. In this study, a resource is defined as any person or a thing that imparts teaching and learning. Khoza (2013a) unfolds the hardware and software resources as follows: Hardware is any instrument utilised in schooling, while software is any material utilised in combination with the tools to show data. Hardware tools are computers, laptops, and mobile phones (Khoza, 2015d), while software tools are Turnitin, GeoGebra, Autograph and Cabri 3D, which are innovative tools for integrating technology in teaching and learning mathematics (Bhagat & Yen Chang, 2014; Jones et al., 2010; Khoza, 2017). On the other hand, ideological-ware is defined as an invisible or intangible aspect of conveying the information to students, coming from within the lecturer's person (Amory, 2010; Khoza,

2013a). Such includes instruction approaches, notions of teaching and learning, as well as knowledge (Jones et al., 2010; Kapp, 2015; Khoza, 2018; Yildiz & Baltaci, 2016). In addition, UKZN plagiarism policy also specifies that the detection controls include the utilisation of external examiners, plagiarism identification software, and other checking mechanisms as prescribed in the systems, policies, procedures, rules, and regulations as useful resources for plagiarism detection.

A study conducted by Dikovic (2009) with the aim of showing how concepts of dynamic geometry can be applied to topics in calculus, with suggested GeoGebra software tools, revealed that resources such as computers have become part of contemporary life, and are widely used to improve teaching and learning. Moreover, resources such as mobile phones, hand-held computers, and wearable computers (Amory, 2010), are useful in cases where aspects of mathematics are not possible with pen and paper. The study further indicates that using computers offers many possibilities, such as having access to mathematics software packages. These packages have many functions, such as instantaneous numerical and symbolic calculations, and presentation graphics, as well as animation in 2D and 3D (Dikovic, 2009). In accordance with this statement, a quasi-experimental study with non-equivalent control group post-test only, designed by Saha, Ayubb, and Tarmizic (2010), was conducted with the aim of examining the effects of using a free software known as GeoGebra in the learning of coordinate geometry among students classified as either high visual-spatial (HV) ability students or low visual-spatial (LV) ability students. The findings revealed that there are mathematical software packages like GeoGebra, SAGE, FreeMat, GeoNet, JLab, Maxima, Axiom, YACAS, and JsMath used in teaching and learning. The study further indicates that GeoGebra software is a free open-source programme which is a popular dynamic software for teaching and learning mathematics. This software provides teachers and students with a free new tool, a new way of using computers with visual aids, to help students interact with the mathematical concepts (Saha et al., 2010).

In addition, Hohenwarter and Fuchs (2004) state that GeoGebra is an interactive geometry software that offers algebraic possibilities as well, such as entering equations directly. Furthermore, geometric software like GeoGebra is used during assignments, projects, and examinations (Baltaci & Yildiz, 2015). GeoGebra helps academics and scholars as well in teaching and learning of definitions, theorems, and problem-solving (Tran, Nguyen, Bui & Phan, 2014).

This geometric software may well enhance the teaching of mathematics topics like geometry and functions (Kapp, 2015). Effective mathematics lessons can also serve to develop the potential of the inner (spiritual, sense, and intention) being (Supardi et al., 2015). GeoGebra contains downloadable videos, notes, formulas, worksheets, PowerPoint slides, and remediation activities which are readily available for utilisation (Nepaya, 2019). A study conducted by Kutluca (2013), investigating the effect of Van Heile geometry understanding levels of students on an 11th grade course, signposted a polygon obtained from n and r values, using GeoGebra software in computer as shown in Figure 2.8 below.

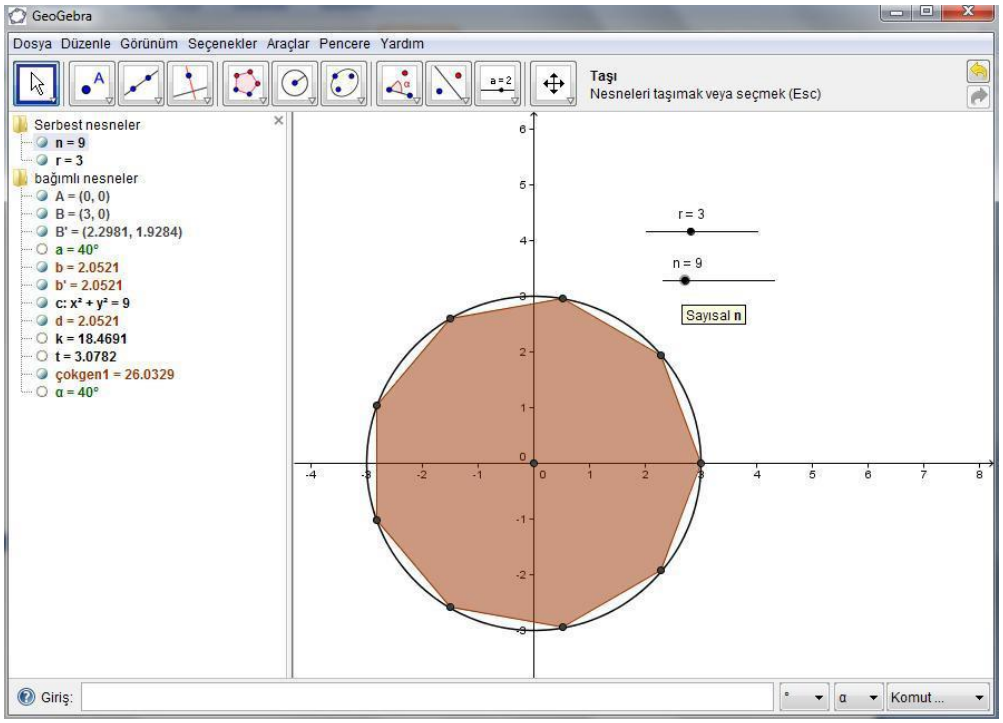


Figure 2. 8: Polygon on the GeoGebra (Kutluca, 2013, p. 6)

The above polygon is acquired through instructional material developed for the instruction of "polygons" unit because the programme offers symbolical and visual capabilities, such as directly pinning equations and coordinates, as well as describing functions in algebraic method (Kutluca, 2013). Another example shows a worksheet of spherical and cylindrical coordinates formed by students on the GeoGebra software, addressing a point on a sphere using its radius at right angles,

as well as a cylinder, using its base and height (Yildiz & Baltaci, 2016), as show in Figure 2.9 below.

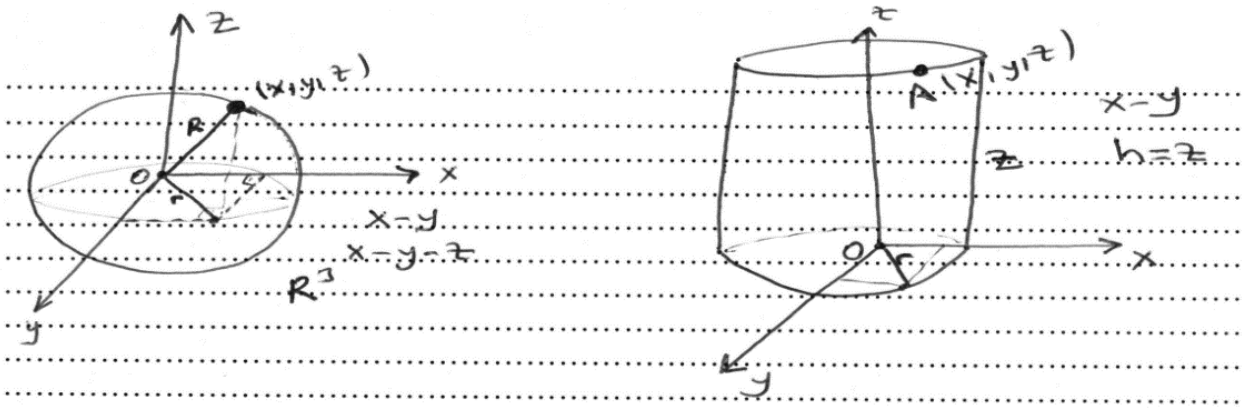


Figure 2.0.9: Cycle and Sphere worksheet (Yildiz & Baltaci, 2016, p. 160)

The above figure is shown on a case study conducted by Yildiz and Baltaci (2016) investigating how eight pre-service mathematics teachers learn cylindrical and spherical coordination in contextual teaching and learning, supported by the GeoGebra software. The study further indicates that lecturers' understanding should go further to give students assignments that require them to use a worksheet, then check the correctness through GeoGebra software screen, as it is displayed in Figures 2.10 and 2.11 below.

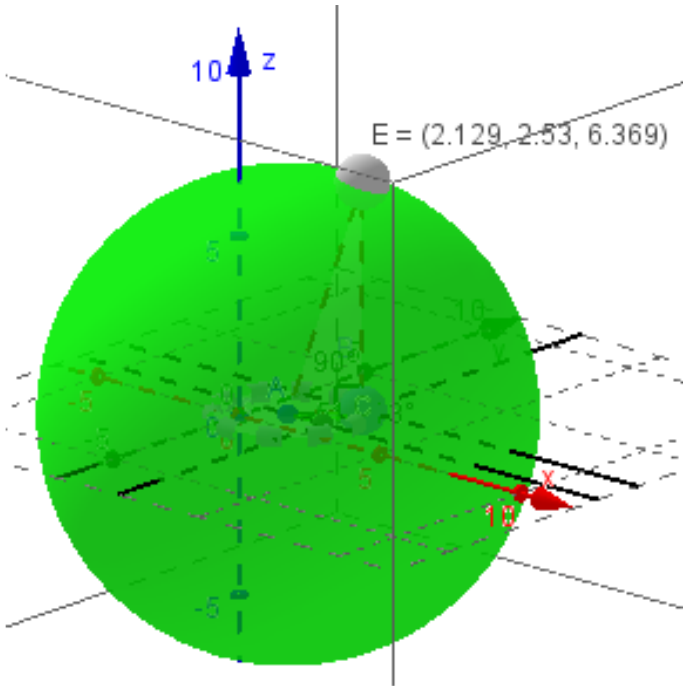


Figure 2.10: Sphere on the GeoGebra (Yildiz & Baltaci, 2016, p. 160)

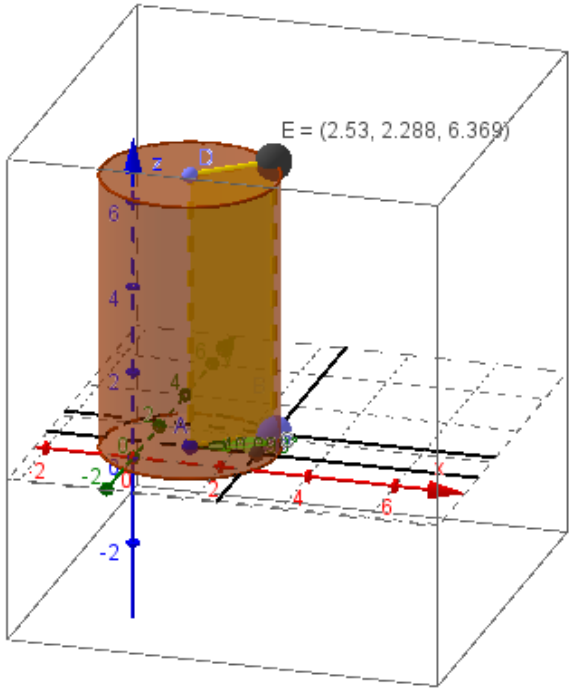


Figure 2.11: Cylinder on the Sphere (Yildiz & Baltaci, 2016, p. 160)

The above generated literature indicates that, most of the time, mathematics is effectively enabled by means of technology. Dehaye et al. (2016), as well as Yildiz and Baltaci (2016) argue that certain areas of mathematics completely depend on resources such as computers and smartphones for calculations, drawing up tables, proving theorems and for using software like GeoGebra, as well as on lecturers' understanding (Khoza, 2016b), the three resources being integrated in technology. In other words, hardware (professional understanding), software (public understanding) and ideological-ware (private understanding) resources are inseparable. According to Khoza (2018), IW resources should dominate HW and SW resources. This is because teaching is about understanding IW resources first, these support the use of HW and SW (Khoza, 2015a, 2017). Qualified lecturers, as human resources, should have a high level of thinking skills, to promote the usage of hardware such as computers, and software resources such as GeoGebra, in mathematics (Khoza, 2015a; Supardi et al., 2015). If the usage of resources is dominated by ideological-ware, this addresses lecturers' private understanding in formulating ideologies to facilitate resource processes (Khoza, 2015a, 2015c). Private needs are about understanding own professional identity as an ongoing process of integrating educational knowledge, everyday knowledge and practices (Khoza, 2017; van den Akker et al., 2009).

In universities, lecturers motivate students to utilise technology to validate their solutions to mathematical problems (Sinclair et al., 2010). In the culture of mathematics, lecturers use GeoGebra during teaching and learning. Students are also expected to use GeoGebra software to help them find solutions when doing their assignments and projects, before uploading their papers onto Turnitin (Tran, Nguyen, Bui, & Phan, 2014). For uploaded mathematics activities onto Turnitin that use GeoGebra software, any similarity will show a high percentage. According to Oghigian et al. (2016) Turnitin, in this case, might filter students' images, drawings and formulae. Therefore, in order to deal with the issue of the students' papers flagged by Turnitin, lecturers should exercise their creative thinking in examining Turnitin similarities (Supardi et al., 2015). It is on this premise that Halgamuge (2017) argues that the level of percentage differs when it comes to writing based on mathematics projects and assignment. In this respect, lecturers are expected to use their professional understanding; during the process of developing understanding, trying to find meaning in the universe (Lavicza, 2010).

This proposes that students' work might gain a higher percentage, indicating that they copied from GeoGebra software when creating images, graphs, equations and formulae that match other sources (Rogerson & McCarthy, 2017). This also suggests that, to deal with Turnitin in mathematics, lecturers need to understand how technology works (Dehaye et al., 2016). Therefore, lecturers should not rely on Turnitin software similarities only; they also need to apply technology of education (lecturers' understanding) during Turnitin utilisation. More technological support has to be provided to lecturers, as remarked by Bibi and Khan (2017). The generated literature above indicates that there is a need for educational institutes to upgrade Turnitin resources which incorporate digital technologies, graphs, tables, equations, theorems, images, mathematics language, as well as vocabulary (Corbin & Bugden, 2018; Muhammad, 2016). Conversely, technology is driven by pedagogy.

2.10 Pedagogy in Mathematics Turnitin

Pedagogy is a key word used in education meaning a skill, and a profession of teaching young people or youth and adults, applying methods and principles of teaching (Kibalirwandi & Mwesigye, 2018). The transformation of pedagogy occurs as the lecturer interprets the subject matter, finding multiple ways of representing it in the classroom, and adopting, adapting, and tailoring the instructional materials to suit students' prior knowledge Youmans (2011). However, (Orim, 2017) is of the view that pedagogy is a set of special qualities that help a lecturer transfer knowledge to others (private and public understanding). Garba (2017) notes that pedagogy includes knowledge of assessment strategies that include appropriate conceptual representations in order to address the problems of students and avoid confusion on concepts, enhancing understanding. In other words, mathematics lecturers should be well versed with the pedagogy; and be able to employ Turnitin to facilitate comprehensibility of the assessment, showing professional understanding.

The above statement is in accordance with studies conducted at California State University by MANCOSA (2014). The intention of the studies was to prove whether the students who were explicitly warned about the use of Turnitin would plagiarise less than students who were not. In two studies, students wrote papers that were checked for plagiarism using plagiarism-detection software. In the first study, half of the students in two classes were randomly selected and told that

their term papers would be scanned for plagiarism, using the software. In the second study, students wrote two papers in each series. The studies discovered that Turnitin gives lecturers feedback about plagiarism by reporting on what percentage of a student's paper contains material that overlaps with previously submitted papers stored in a database (professional understanding). This percentage alone does not disclose whether or not plagiarism has occurred. Therefore, the importance of lecturers' having an understanding of their pedagogy translates to them being able to interpret the difference between appropriateness and dishonesty, to fairly judge students' work Garba (2017). This indicates lecturers' private and public understanding and suggests the need for pedagogical support throughout their studies (MANCOSA, 2014).

According to Özbek (2016) and Oghigian et al. (2016), Turnitin does not check for plagiarism in a piece of work. Instead, Turnitin checks the work against the database: if there are instances in which the writing is similar to, or matches against, one of the sources, this is flagged for the lecturer to review. It is perfectly natural for an assignment to match a database. If one has used quotes and has referenced correctly, and there are no instances of a match, this indicates professional understanding. The percentage of text that matches is presented in a colour-coded report that indicates each instance of plagiarism and its original source. However, these colour-coded labels must not be used for final detection, as they provide a summary of matching or similar areas of text found in a submitted paper (Bensal et al., 2014; Garba, 2017; MANCOSA, 2014). Moreover, Turnitin uses colour codes to rate the percentage of the similarity index, and show which part of the submitted work matches another work (Ball, Thames, & Phelps, 2008; Khoza, 2015d).

A paper of Berkvens et al. (2014) investigated the functionality and accuracy of Turnitin applied to 68 science and engineering research papers, and the potential use of software in a second-language context. The findings of the paper indicate that Turnitin can be useful, particularly as a pedagogical, rather than a policing tool. However, colour-coded percentages can be misleading because of inaccuracies. In that case, lecturers should put their pedagogy into use when it comes to interpreting an originality report Berkvens et al. (2014), demonstrating their (private understanding). In line with these views, a study of Khoza (2016) was conducted on two participants out of twenty university Bachelor of Education honours students who specialised in

curriculum studies. The purpose of the study was to explore postgraduate students' understanding of curriculum visions and goals in teaching their subjects. This study indicates that, in this case, lecturers put their private understanding at the centre of assessing context, which helped lecturers to understand and find their identity. Private understanding helps lecturers choose whether to take professional or public understanding in their assessment. The possible similarity indices are shown below, according to the percentage and colour codes, as indicated in (MANCOSA, 2014).

Table 2.11: Percentage Code

Percentage	Code
Blue	No matching text
Green	One word to 24% matching text
Yellow	25-49% matching text
Orange	50-74% matching text
Red	75-100% matching text

A study conducted by Sariffuddin, Astuti, and Arthur (2017) used a mixed-methods approach. A quantitative approach was conducted, using the software Turnitin.com to scan for plagiarism at the level of the student assignment. This study supports the study of MANCOSA (2014), that Turnitin is divided into five categories appearing in different codes with colours ranging from blue to red. In this study, each code describes the plagiarism level as follows. Blue indicates that there is zero similarity; green indicates low degree of similarity; yellow indicates a moderate degree of similarity; orange indicates that there is above-average level of similarity. Red shows a very high level of similarity. The results report from Turnitin cannot guarantee that all the assignments that fall under green or blue were not plagiarised, nor that all the assignments or theses falling under yellow to red contain plagiarism (Goddard & Rudzki, 2005). These codes are merely helpful to lecturers when used in document review, to examine the strings detected by Turnitin on whether there was any plagiarised material, an attempt to paraphrase, or whether a citation was given (Oghigian et al., 2016).

The percentages and colour codes generated by a Turnitin report are guidance to lecturers which they are expected to scrutinise before being certain whether or not plagiarism has occurred. This further suggests that lecturers should never take for granted any of the originality results flagged

by Turnitin. If they turn a blind eye to the blue and green codes, it might still be that plagiarism has occurred. On the other hand, lecturers might pay attention to yellow, orange, and red colour coding only, which in most cases has a higher percentage of similarity. Lecturers might find that, in most cases, where red coding indicated that a 100-per-cent text match existed, this could be because the thesis has been uploaded to Turnitin more than once. The theses, when checked against one another, will appear precisely the same (Sutherland-Smith & Carr, 2005). Therefore, Turnitin and similarity software cannot detect plagiarism, but only identify and highlight strings of text that match those of other sources (Mphahlele & McKanna, 2019). Pedagogy is determined by the content.

2.11 Utilising Turnitin for Mathematics Content

Content indicates a wide range of aspects, such as knowledge, and teaching of subject matter, and applies in diverse topical areas (Ball et al., 2008). The University of KwaZulu-Natal policy specifies what the lecturer might look for in the content as revealed by Turnitin. The policy specifies that all students are expected to be educated in correct academic practice, including writing and referencing, early in their careers at the university. Students should know what is expected of them, and understand the meaning of plagiarism and its consequences. In addition, the university provides TII training programmes to offer guidance for staff members on how to utilise Turnitin, following optional settings like

Exclude small matches?

- Yes
- No

Choose between

- Word count:
- Percentage

Allow students to see originality reports?

- **Yes**
- No

Submit papers to:

Standard paper repository:

- original

- Stationary
- Warehouse

In this same view, a research conducted by Şimşek and Boz (2016) analysing PCK in the field of mathematics education in Turkey, using the meta-synthesis approach, focused on 56 studies. Amongst these were 24 dissertations, 27 journal articles, and five conference proceedings, published between 2004 and 2015, which were analysed thematically and methodologically. The results show that the content of mathematics consists of algebra, measurements, geometry, trigonometry, and statistics. The participants' responses concerning mathematics content were deduced from a critical-action study carried out by Khoza (2018) on Grade Twelve mathematics teachers who reflected on their experiences and practices of digital resources. The teachers indicated geometry, algebra, and trigonometry as the backbone of mathematics. According to Chogo et al. (2017), in geometry, there are a number of difficulties different in nature from those of trigonometry and algebra. Geometry involves theorems. For example, an article Wiggins (2018) was presented during the annual national congress of the Association for Mathematics Education of South Africa (AMESA) at the University of the Free State, where four different ways of proving the negative reciprocal relationship between the gradients of a perpendicular line were explored. The finding shows the example of how the theorem of Pythagoras' Proof 1 is achieved, as shown in the figure below.

STATING THE THEOREM

Suppose $y = m_1x + c_1$ and $y = m_2x + c_2$ are two straight lines with $m_1, m_2 \neq 0$. If the two lines are perpendicular to one another then $m_1 \times m_2 = -1$.

PROOF 1 – THEOREM OF PYTHAGORAS

Let L_1 and L_2 be perpendicular lines with equations $y = m_1x + c_1$ and $y = m_2x + c_2$ respectively. Without loss of perpendicularity we can translate these two lines so that they both pass through the origin. Let us call these translated lines L_3 and L_4 respectively. Now draw vertical line $x = k$ $(k \neq 0)$ as illustrated in Figure 1. The vertical line cuts L_3 at $A(k; m_1k)$ and L_4 at $B(k; m_2k)$.

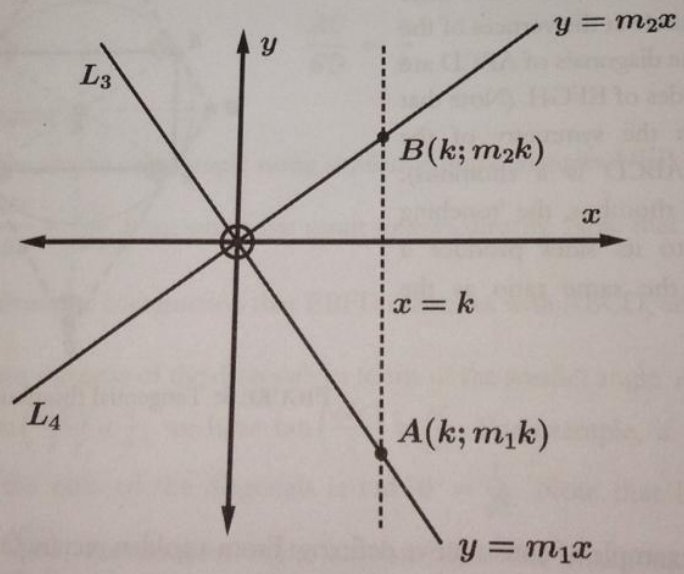
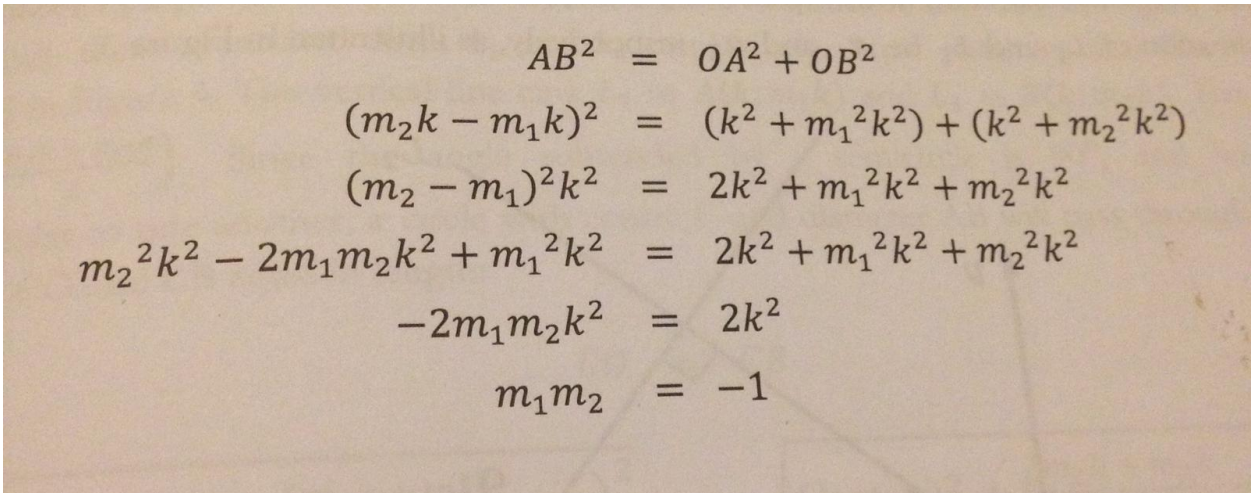


FIGURE 1: Lines $y = m_1x$, $y = m_2x$ and $x = k$.

Figure 2.12: Pythagoras' theorem (Wiggins, 2018)

Since lines L3 and L4 are perpendicular, triangle BOA is right-angled. By applying the Pythagorean theorem obtained by (Wiggins, 2018), as shown in Figure 2.6 below.



$$
\begin{aligned}
AB^2 &= OA^2 + OB^2 \\
(m_2k - m_1k)^2 &= (k^2 + m_1{}^2k^2) + (k^2 + m_2{}^2k^2) \\
(m_2 - m_1)^2k^2 &= 2k^2 + m_1{}^2k^2 + m_2{}^2k^2 \\
m_2{}^2k^2 - 2m_1m_2k^2 + m_1{}^2k^2 &= 2k^2 + m_1{}^2k^2 + m_2{}^2k^2 \\
-2m_1m_2k^2 &= 2k^2 \\
m_1m_2 &= -1
\end{aligned}
$$

Figure 2.13: Application of Pythagoras *(Wiggins, 2014)*

The above answer is what is expected from any different method used. As indicated in Figure 2.13 above, geometry is primarily abstract in nature (Chogo et al., 2017). Since geometry is abstract in nature, it requires professional understanding. Lecturers have to read more studies on geometry and attend formal professional development programmes (Bansilal et al., 2014; Khoza, 2015b, 2018).

However, algebra involves addition and subtraction of positive and negative integers (Confrey et al., 2010), in which students are expected to solve equations like -2(4x-y) +3 (-2y-4) = … (Gravemeijera, Bruin-Muurling, Kraemer, & van Stiphout, 2016). These researchers indicated multiplication and division tasks that involve, for instance, fractions multiplication, such as part of 35 and 5 x 41. In measurements, for example, students are expected to calculate the area of a rectangle and a triangle represented on a map (Vale, 2013). Furthermore, it was stated that, to find the area of a rectangle and a triangle, there is a formula to be followed (Vale, 2013). Additionally, mathematics is full of powerful standard methods, developed over centuries, for solving many types of tasks. There are rules for determining the properties of geometrical objects and steps of problem solving (Ersoy & Güner, 2015; Lithner, 2017). According to Ersoy and Güner (2015), the use of suitable problem-solving strategies are significantly successful in problem-solving. In other words, students who understand the problem, start to think mathematically at the level of moving on to the solution by choosing the correct strategy (Ersoy & Güner, 2015), indicating personal understanding. In other words, to think mathematically, students have to understand numbers and

calculations first, which they bring to school from their previous knowledge (Khoza & Biyela, 2019).

On the other hand, trigonometry is defined as an important part of mathematics taught in high schools (Fahrudin, Mardiyana, & Pramudya, 2019). A mixed-methods approach study of Dündar (2015) was conducted, assessing the performance of 51 teacher-candidates on trigonometry problems represented in different formats. The focus was to examine the reasons for test failures, these candidates being enrolled in the Department of Mathematics Education at a state university. The findings reveal that trigonometry concepts are better achieved when applied in real life, and shared with others. Dündar (2015) further asserts that, if trigonometry is used to solve problems related to real-life situations, such as calculating the length of a shadow, while using and understanding the importance of tangent ratio, there is a better understanding. This statement is an indication of public understanding. According to Khoza (2018), if the content is based on geometry, it addresses professional understanding; if it based on algebra, it addresses the private understanding; and if it is based on trigonometry, it addresses the public understanding.

Therefore, in mathematics, marking of content differs from that of other subjects like languages, where it is possible to write about different topics and to offer diverse views. In accordance with this statement, in languages, it is possible for students to develop their own topics, applying the system correctly in their compositions, using the correct quotation, citation, and paraphrasing (Wahyuni, 2017). It is also possible for students to paraphrase lifted texts in order to avoid detection by Turnitin (Mphahlele & McKanna, 2019). Nevertheless, students are expected to learn mathematics vocabulary, which is not common to everyday language usage, as well as unusual mathematical language (Craig, 2007). Craig (2007) further emphasises that calculated solutions in mathematics presenting information in symbolic notation, tables, or graphs, is common. In general, Turnitin always shows high percentage similarity (Sutherland-Smith & Carr, 2005), in content of mathematics uploaded. This is because of the similar answers, tables, symbols, common vocabulary, and formulae used in mathematics. The implication is that, even when various strategies of problem-solving are used, the same answer results, and as such, with a high similarity index, is flagged when submitted to Turnitin. Conversely, a low similarity index is an indication

that the solution arrived at by the students is incorrect; and it might be the cause of using fruitless strategies.

A study was conducted by Schubotz et al. (2019). The study reported on an exploratory analysis of the forms of plagiarism observable in mathematical publications, which were identified by investigating editorial notes from zbMATH. Findings from the study reveal that it is important that Turnitin be utilised in conjunction with traditional text-based detection, which is manual detection. The reason is that Turnitin is insufficient for reliably matching the quality of formulae, and figures extracted from texts of students (Schubotz et al., 2019). The lecturer has the following options during marking using Turnitin, namely: (1) set the number of words that are compared for matches; (2) exclude bibliographic materials from similarity checking; and (3) exclude materials within quotation marks (Razon et al., 2017). This kind of knowledge is obtained from Turnitin (TII) training programmes offered within the university, like the one conducted by Chetty (2014). According to Hoadley and Jansen (2014), if lecturers are not aware of the options provided by Turnitin, they will lack the content knowledge; which might result in lecturers struggling to select and sequence content appropriately, to ensure conceptual development (Hoadley & Jansen, 2012).

In addition to the above-mentioned options, Crannell (2014) supports Razon et al. (2017) when stating that lecturers might use electronic tools in Turnitin.com or PDF pen to create comment stamps for comments they make on a particular assignment. Crannell (2014) further adds that the following might be created during the marking process: First, creation of solution sets that include correct solutions and common mistakes. Second, creation of a code sheet for common mistakes. Last, creation of a grading rubric which is given to students beforehand. In other words, the set-up system within Turnitin allows lecturers to devise a new percentage (Oghigian et al., 2016), by adjusting the percentage from the common vocabulary, language, tables, formulae and equations within the mathematical context, which cannot be changed. Therefore, content knowledge enhances lecturers' understanding in interpreting of originality report from Turnitin during assessment (Rolfe, 2011).

2.12 Utilising Turnitin for Assessment in Mathematics

Assessment is one of the key components of the evaluation experience in the education curriculum (McCracken et al., 2011). This study examines lecturers' understanding of Turnitin utilisation, therefore Turnitin is part of an assessment. In the light of this statement, Boud and Falchikov (2006), together with Buckley and Cowap (2013), offer the view that assessment is a method of inspecting students' level of understanding, identifying a means of helping them to improve their learning style. According to Kumar and Pathak (2015); Bonham (2018); Curtis and Vardanega (2016); MANCOSA (2014), as well as Penketh and Beaumont (2014), there are three types of assessment in teaching and learning, namely: summative assessment (professional understanding), formative assessment (private understanding), and peer assessment (public understanding). A study by Kumar and Pathak (2015), which discusses the kinds of practices that are needed to refocus assessment with higher education courses, reported that summative assessment (professional understanding) concentrates on the immediate needs of detection and punishment in assessment. Formative assessment concentrates on utilising Turnitin to identify suspected cases of plagiarism in order to improve the quality of students' writing and knowledge of plagiarism (Kumar & Pathak, 2015). On the other hand, a paper written by Walchuk (2016) remarked that the purpose of formative assessment is to provide a clear understanding of plagiarism and its related concepts. This paper adds that peer assessment occurs when students are engaged in peer-review evaluations, learning from each another's work and facilitating management of peer-review exercises.

A study conducted by Siddique (2017) discusses the complete working of Turnitin, and briefly gives the limitations of the software. This study is in line with the above assertion that Turnitin offers three main services during assessment. The first one is Grade Mark, a tool used to provide online marking of students' submissions, evaluating them accordingly (professional understanding). The second is originality check, the main Turnitin tool which checks for the overlapping pieces of submissions against the documents in the database of Turnitin. Third, is a peer mark used as a tool to provide students a peer review of what they have submitted (public understanding). In approving the study conducted by Siddique (2017), the UKZN supports staff members by conducting Turnitin training like the one by Chetty (2014). Concerning steps of dealing with the Grade Mark tool, for example, Turnitin gives an option on what to attach, such as

(i) choosing to attach a rubric or a form to the attach assignment, (ii) create a rubric; that is to launch rubric or form manager, or (iii) find rubric best suited to your assignment, in Turnitin teaching tools. In addition, there is an option allowing lecturers to choose whether to save the above-mentioned options as their default assignment. Thus, Turnitin training indicates that lecturers are trained to prepare them to utilise Turnitin in their teaching and practice as part of their assessment.

The following studies concur with Siddique (2017) statement, that grading increases the ability of lecturers to detect plagiarism and apply penalties for rule-breaking (professional understanding). Originality check is utilised to help locate the sources of plagiarised work in submitted projects, and could also enable lecturers to identify students who might need support with their writing, offering informative feedback (private understanding). In peer-assessment mode, students can also provide feedback for one another, discussing possible misconceptions (public understanding), as offered by Naka and Nagoya (2015). Grade Mark takes professional understanding. The lecturer is forced to apply harsh punishment to work that is plagiarised, whether it happened intentionally or unintentionally (Rashid & Rashid, 2018). As specified in the UKZN policy, plagiarism, whether deliberate or unintentional, is a form of cheating and is unacceptable. A paper was written by Khalil, Rania, and Fahim (2017) aiming to fill the gap in the literature with regard to utilising assessment for learning purposes. This paper indicates that originality check is undertaken on private understanding: Turnitin is utilised to assist lecturers identify areas of weaknesses in students' writing. Conversely, peer review undertakes public understanding, when Turnitin is used to facilitate the management of peer-review exercises, so that students can assess and develop their knowledge from their peers (Rashid & Rashid, 2018).

Assessment in Turnitin utilisation is crucial regardless, whether it is summative, formative, or peer-reviewed. Hence, lecturers need to understand that Turnitin is unable to select properly sourced material such as quotations, references, and random occurrences of text, simply representing these findings in their similarity indexes (Bemmel, 2014). This assertion is supported by Orim (2017), who argues that Turnitin cannot detect all types of plagiarism, most significantly the theft of ideas, during assessment in mathematics. The point is to have observant lecturers to identify any problem work, being able to utilise Turnitin as an aid in assessment, rather than as the

only assessment mechanism (Bonham, 2018). Lecturers should be advanced in terms of utilising Turnitin during assessment process. However, according to Deubel and Ohio (2018), some lecturers are struggling with the issues of using Turnitin, which makes this difficult for them. As a result, such lecturers sometimes ignore cheating because they are not familiar with Turnitin. They might lack understanding of policies and implementation (Mphahlele et al., 2010). There is a need for lecturers to have an understanding of summative, formative, and peer assessment requirements (Mashau, 2017). Furthermore, the author recommends that training of the lecturers might be the solution to understanding how Turnitin works in assessment. Lecturers may then be in a good position to make decisions (Gumbo, 2018) based on the report generated by Turnitin, in order to utilise effective procedures.

2.13 Procedures for Utilising Turnitin in Mathematics

There is no one specific assessment process that is either wrong or right. The selection of teaching method depends on each particular lecturer. It is also unusual that one method is sufficient for teaching and learning. Students are unique, and they understand differently, therefore a combination of teaching methods is necessary. Sharing the same light, Hoadley and Jansen (2014) identify three types of teaching method that might be utilised in assessing the uploaded work from a Turnitin report. These include product procedure (professional understanding), process procedure (personal understanding), as well as the interactive and critical procedure (public understanding). Product procedure is about following the policy on plagiarism, the list of methods to detect it, including appropriate penalties that will be applied for each occurrence (Hoadley & Jansen, 2013). In process procedure lecturers detect to address the problem through introduction of an academic writing skills course (Anney & Mosha, 2015). Interactive and critical procedure is about lecturers detecting and understanding how assessing procedures, political empowerment within the community affects and shapes them (Hoadley & Jansen, 2014; Kehdinga, 2014b).

If lecturers are influenced by professional understanding, Turnitin is utilised as a method of dealing with external motivation factors which encourage more punitive use of the programme for academic misconduct (Buckley & Cowap, 2013; Orlando, Hanham, & Ullman, 2018). Assessing procedures driven by personal understanding of utilising Turnitin clearly indicate which sections of the text are not original. The lecturer can explain academic honesty using the students' own

papers as examples (Ward, 2016) to develop students' writing. In terms of lecturers who are influenced by public understanding, Orlando et al. (2018) recommend that such lecturers, especially those with limited understanding of Turnitin, might consult experts on Turnitin to assist them, while examining student papers through Turnitin.

Therefore, the assessment procedure for detecting plagiarism depends on an individual lecturer's understanding. Understanding whether the assessment method of detecting plagiarism is driven by professional, private, or public factors does not mean that lecturers should utilise simply any method. Lecturers do not need to apply the same procedure to assess work of different students; they need to formulate various methods for diverse situations (Orim, 2017). In other words, lecturers can influence the improvement of writing skills by adjusting and changing detecting procedures to suit individual students (Appiah, 2018). This implies that lecturers should use the procedures appropriate to achieving objectives of utilising Turnitin (Hoadley & Jansen, 2014). There are lecturers who do not use Turnitin. This also implies that some of these lecturers are deliberately not utilising Turnitin.

In most cases, mathematics deals with many numerical calculations, therefore Turnitin might not be helpful in this subject (Gumbo, 2018). Furthermore, a study of Curtis and Vardanega (2016) was conducted to record students' perceptions about learning technologies, focusing mostly on learning software. The findings of the study reveal that various higher institutions in South Africa are utilising Turnitin to improve teaching; however, some lecturers are faced with challenges because of their limited experience. To overcome such challenges, Education (2000) suggests that experienced lecturers, especially those who have seen the benefits of using Turnitin, should mentor those who are inexperienced. However, this kind of knowledge is not recommended in the professional field because if lecturers depend on other lecturers without school knowledge, they are left with everyday knowledge (Obara et al., 2018).

This implies that such lecturers ultimately have to depend on both public understanding and private understanding. This also suggests that most lecturers should be trained and exposed to various methods of utilising Turnitin (Education, 2000). Moreover, educational procedures such as academic-integrity-mastery training should be combined, in university-wide methods on the

problem of plagiarism, with a range of other policies and interventions. Such would include Turnitin, clear assessment expectations for students, and strong enforcement measures for breaches of academic integrity standards (Esuh Ossai-Igwe & Nurahimah, 2013; van den Akker et al., 2009). The UKZN provides TII training methods for all staff members to follow. For example, Chetty (2014) conducted TII training, taking the staff members through the following seven steps of utilising Turnitin:

Seven (7) steps to follow creating an account of Turnitin:

(i) Create a TII account (ii) Wait for TII to email link (iii) Link your account with the class ID and password supplied (iv) Read help file (v) Add a class (note the class ID [7digit numbers] and password (vi) E-mail students the class ID and password and (vii) Click on class and add assignment. There are set options whereby students create an account, selecting the student option. More so, lecturers should be able to distinguish between correct and unproductive strategies that might lead to correct or incorrect solutions (Bansilal et al., 2014). However, procedures are driven by lecturers' role.

2.14 Lecturers' Role in Utilising Turnitin

The role of a competent lecturer, according to the policy of educators, is described as the demonstrated ability to integrate theory and practise of different roles in teaching (Council, 2000). In terms of the UKZN plagiarism policy statement, it is indicated that all staff within the university are responsible for the prevention, detection, and reporting of plagiarism (Vithal, 2009). The policy also states that the responsibilities for lecturers are to:

- Be familiar with the available plagiarism identification software, and encourage students to use it to detect plagiarism before submission of work
- Be alert to and document any instances of plagiarism when examining any work
- Ensure allegations of plagiarism are based on sound, well-documented evidence
- Follow the correct procedure of this policy if plagiarism is alleged, and not take any unilateral, punitive action against any student without first following procedure.

The following studies indicate the lecturers' role in the use of Turnitin as instructor, facilitator and researcher (Ayon, 2017; Bathmaker & Avis, 2005; Glendinning, 2014; Obara et al., 2018; van den Akker et al., 2009). A study was conducted by Sarwar et al. (2016), intending to explore the M

Phil scholars' views regarding the role of plagiarism-detecting software for improving the quality of research work. The sample of the study was thirty scholars from the three public-sector universities of central Punjab. The results from this research reveal that the duty of the instructor is to check the originality of work. On the other hand, the results of a case study conducted by Obara et al. (2018) captured individual teachers' responses to their conceptions of technology and school policy on technology. It studied how teachers actually or intentionally used technology, clarifying the roles teachers played in the use of technology. The outcome of the study indicated that lecturers, as facilitators, should help develop students to use Turnitin. A case study conducted by Snowball et al. (2015) on mathematics teachers, captured their responses to the conceptions of technology, and how they actually or intentionally used technology. The study's contribution to the literature indicates that the lecturers' role in the use of Turnitin is a researcher-lecturer. The implication is that, being a researcher means to achieve ongoing personal, academic, occupational, and professional growth, pursuing studies and research in the utilisation of Turnitin (Glendinning, 2014).

Thus the role of the instructor indicates professional understanding; the facilitator indicates private understanding, while the researcher indicates both the private as well as public understanding. According to Singh and Remenyi (2016), the role of the instructor is to detect and treat any serious academic misconduct adequately, in order to tackle the problem effectively. The authors further state that it should not end there, but the instructor should also execute a severe penalty for those who engage in plagiarism (Singh & Remenyi, 2016). Esuh Ossai-Igwe and Nurahimah (2013) state that a facilitator is pushed by personal attributes, qualities, and traits that would assist the lecturer to achieve better detection, which arises from within the individual, and remains fairly consistent throughout life. Obara et al. (2018) argue that researchers continually improve their practice by learning from and with others, exploring proven and promising practices that encourage Turnitin, to improve student writing.

Normally, universities trust lecturers to go beyond detection, deterrence, and punishment, playing their roles to promote a culture of academic integrity (Esuh Ossai-Igwe & Nurahimah, 2013). For instance, students are given an assignment to load to Turnitin. These students were required to draw a frequency table (as displayed below) of raw data on the number of cars in a car park,

manufactured by various companies. Students were required to construct and interpret the bar (Ijeh, 2012).

Table 2.2: Number of Car Makes

Company	Nissan	KIA	VW	Tata	Toyota
Number of cars	5	3	10	4	9

There is no doubt that the table and bar graphs look the same if done correctly, but the interpretation of the graph might not look exactly the same. What might be in common would be vocabulary used by students. Auslander, Smith, Smith, Hart, and Carothers (2016) conducted a research from a trial with international graduate coursework students in their initial year at the University of Australia, undertaking a preparatory course. This study reveals that, based on the above assignment, an instructor interprets the originality report correctly by understanding how the matches work, and what they might mean. In this case, an instructor might detect and punish a student when Turnitin shows similarities in the interpretation of the bar graph, where students use their own interpretation, following professional understanding. At the same time, the lecturer who takes the position of instructor might be compelled to manually detect the possible plagiarism. This implies that the culture of mathematics most of the time compels the instructor to go beyond detection, deterrence, and punishment, owing to the graphical nature of the work (Hanbidge et al., 2018). The culture of mathematics reproduces tables, figures, the cited captions of tables or figures, phrases specifically taught to students, common terminologies, images, and graphs (Kochneva & Romanova, 2019; Oghigian et al., 2016; Usiskin, 2012).

It is also possible that a mathematics lecturer decides to take the position of a facilitator. The lecturer must display facilitation, by means of guidance, motivation, and support, giving students enough time to do whatever it takes to assist them when necessary (Singh & Remenyi, 2016). According to van den Akker et al. (2009), the facilitator should motivate students to utilise Turnitin in order to improve their academic text, especially when students are supposed to apply their knowledge. In the example mentioned above, in interpreting a graph, a facilitator gives students the chance to see the originality reports of their drafts, discussing these with them (showing private understanding). Such might help students differentiate between legitimate borrowing and

plagiarism (Naka & Nagoya, 2015). This might also allow lecturers to better understand their students, and to encourage students to acknowledge sources (Stappenbelt & Rowles, 2009).

A multiple case study was carried out by Edwards (2014) on two groups of 12 prospective elementary teachers completing distinct mathematics content courses. Findings from the study reveal that a researcher has to investigate whether the similarities detected by Turnitin constitute plagiarism, especially in the case of mathematics. Furthermore, public understanding occurs when mathematics lecturers collaborate with colleagues and students, in order to share ideas on utilising Turnitin (Edwards, 2014). Moreover, students should be encouraged to monitor their own progress, helping one another in the learning process of Turnitin (Özbek, 2016). More importantly, lecturers, as well as students, should familiarise themselves so as to do more conference publication and internal publication on Turnitin, to improve their research productivity (Basak, 2014). These publications might empower lecturers to understand how Turnitin operates in mathematics. As Razon et al. (2017) state, Turnitin identifies higher similarity scores in mathematics than in social sciences, even when there is no actual plagiarism. In other words, Turnitin itself cannot make a decision on whether plagiarism has occurred (Halgamuge, 2017): a researcher should make that judgment.

This implies that instructors, facilitators, and researchers must be aware of the false positive and false negative outcomes (Schubotz et al., 2019). It is important for lecturers to examine matching results closely and effectively for accurate and correct detection, to avoid negative assumptions and accusations (Walchuk, 2016). Therefore, private understanding helps lecturers to choose whether they follow public or professional understanding in assessing students' work (Cahillane et al., 2016). Lecturers should read more literature to support their decisions with professional evidence (Farrelly et al., 2018). Lecturers' roles as instructor, facilitator, and researcher might be integrated if there is a need, as long as integration is supported by professional understanding of Turnitin utilisation (Sariffuddin et al., 2017).

2.15 Platforms and Intervals of Utilising Turnitin

Utilisation of Turnitin might occur in class as well as outside the university environment (Arora & Pany, 2018), whereas time is not distributed enough across domains (Ward, 2016). To support this

statement, Ryan and Risquez (2018) conducted a study on the outputs of a focus group examining the perceived uses, enablers, and barriers to utilising an effective teaching environment, amongst a small group of postgraduate teachers. The outcome of this study indicates that lecturers might use an inside and outside environment at different times, implementing a blended environment. The study further reveals that the delivery for blended environment promotes flexible access for and coordination for part-time students. An inside environment indicates professional understanding. Corroborating this, a mixed-methods study conducted by Oluikpe (2013) examined the e-conferencing method in the teaching of academic literacy skills to combat the problem of plagiarism in research writing among second-language postgraduate students. Findings from the study indicate that, in the university environments, lecturers and Turnitin experts highlight plagiarism issues. In an inside environment, time is spent with lecturers to develop their understanding of utilising Turnitin, marking expectations, use of quick marks, and overall summary of feedback (Liu & Taylor, 2014). The outside environment indicates private and public understanding, in the sense that lecturers create an environment that helps them to understand utilisation of Turnitin (Khoza, 2016b) in the outside world, using their own time.

Thus lecturers are capable of choosing to utilise Turnitin either inside or outside of the university, or to blend them creatively (Rohmad & Wahyuni, 2018). A blended approach is recommended when assessing students' work. According to Singh (2016), a face-to-face environment is highly significant in universities (professional understanding), since it provides room for brainstorming, or discussion of common problems which students have experienced in their academic writing (Augusto, McCullagh, McRoberts, & McNair, 2010). However, a case study of Chew et al. (2015) concluded by indicating professional, private, and public understanding when enlightening that Turnitin software supports the core of assessment, enabling lecturers to be adaptive to the situation at that time, either to be engaged indoors or outdoors. The purpose of this study was to present a revised curriculum for introductory biology that provided a scaffolded environment in which students are encouraged to explore and develop their scientific reasoning skills in authentic theory and practise sessions.

According to Liu and Taylor (2014) the lecturers' use of Turnitin to support inside instruction environment in Academic Writing class has a positive impact on students' awareness on avoiding

the dangers of plagiarism. Furthermore, there will always be a demand for face-to-face lectures, to address the needs of the future educational environment (Chew et al., 2015; Liu & Taylor, 2014) (professional understanding). In fact, lecturers are irreplaceable; however, they may not always be available when and where the students need assistance (Ryan & Risquez, 2018), such as in cases where students had no access to view originality reports in time (Havemann & Sherman, 2017; Howard, Khosronejad, & Calvo, 2017). In that case, lecturers might choose whether they use online lectures or interactive lectures, as remarked by Ranawella and Alagaratnam (2017); conducting lessons and conversations about utilising Turnitin (Appiah, 2018) (professional and private understanding). Most importantly, lecturers, however, perceive this time gap positively, as students are motivated by Turnitin to hand in the coursework much earlier than expected (Chew et al., 2015).

The above reviews indicate that lecturers' understanding of space and time of utilising Turnitin is determined by the situation at that time. In addition, lecturers should be flexible enough to utilise Turnitin inside (professional), outside (private and public) and in a blended (professional, private and public) environment, depending on the time they have. However, there are lecturers who feared that the online assessing approach was there to replace them, and that they might eventually lose employment (Singh & Remenyi, 2016). These lecturers prefer a face-to-face environment, which allows them to identify any commonalities or concerns about individual students. It also enables appropriate interventions to be made, with more focused feedback (Obara et al., 2018). Such lecturers lack understanding of the blended approach, which is significant in terms of utilising Turnitin, as indicated in the reviews above.

Ritchie et al. (2013) argue that the reason of this assumption is that such lecturers are not used to the current research trend. Even if they know it, some of them lack understanding of using both an inside and online environment. The aim of the study was to measure the extent of the software usage by Kotelawala Defence University (KDU) academic staff. This was conducted through a survey, in order to propose measures to enhance its usage. This would improve the quality of research and knowledge of research ethics by both academics and students of KDU. In addition, amongst other reasons revealed from the findings of the study, some lecturers do not want to spend time on checking documents for plagiarism, as this consumes much time; whilst others do not

attend workshops and seminars conducted by the library. Consequently, they do not have the required skills to handle Turnitin. In the same line of argument, the TII training conducted by Chetty (2014) proves that the universities do provide training for lecturers, giving support with search options of the location of student papers, for example. During training, lecturers who attend are shown search options as follows:

- ✓ Student paper repository
- ✓ Current and archived Interne (Chetty, 2014).

Lecturers who do not attend such training might not utilise Turnitin, or they might assess students incorrectly. This may have an undesirable impact on their education improvement, as well as on upcoming education (Wahyuni, 2012). Therefore, the solution to this problem would involve creating teaching environments in universities that would invite lecturers to become highly engaged with their Turnitin software (Creswell, 2013 ; Ritchie et al., 2013). This indicates that the effective professional development could be successful in increasing the integration of Turnitin in the mathematics classroom when the training is relevant (Petty et al., 2012). Table 2.2 below shows the curriculum concepts that are discussed above.

Table 2.3: Curriculum Concepts

Curriculum Concepts			
	Proposition 1	Proposition 2	Proposition 3
Rationale	Professional understanding	Personal (private) understanding	Societal (public) understanding
Goals	Objectives	Aims	Outcomes
Resources	Hardware	Ideological-ware	Software
Content	Geometry	Algebra	Trigonometry
Activities	Examinations	Assignments	Presentations
Assessment	Summative	Formative	Peer
Procedures	Product	Process	Critical
Role	Instructor	Facilitator	Researcher/ collaborator
Platform	Face to face	Online	Blended
Interval	Working time	Spare time	After work

2.16 Summary

This chapter reviewed existing related literature on studies conducted both at local and international levels around the discourse of lecturers' understanding of Turnitin utilisation as a phenomenon. The chapter also reviewed various types of plagiarism which lecturers should be aware of. Furthermore, three reasons for utilising Turnitin − detection and punishment, detection and education, and detection and sharing were also presented in the review. In addition, the importance of having an understanding of policy background was also discussed. Furthermore, the content as concept that was generated from the literature indicates that we should consider content knowledge. The resources that are used when utilising Turnitin are hardware, software, as well as ideological-ware, indicating technological knowledge. Moreover, concepts such as assessment, teaching procedures, lecturers' role, platform and interval indicate pedagogical knowledge. This

implies that technological, pedagogical, as well as content knowledge may be a relevant framework for this phenomenon.

CHAPTER 3: THEORETICAL FRAMEWORK

3.1 Introduction

In the previous chapter, a review of related literature was carried out. In this chapter, the theoretical framework which guides the study is presented. A study conducted by Koehler et al. (2013) as well Grant and Osanloo (2014), state that a theoretical framework in a dissertation is explained as a metaphor, the 'blueprint' of a house. The study reveals that the theoretical framework is the design for the whole dissertation inquiry. It also directs and leads to building and supporting the study, which consists of the selected theory that strengthens one's understanding of and planning when about to research a particular topic (Grant & Osanloo, 2014). This statement indicates the importance of thinking through the applicable theory supporting the knowledge, based on the phenomenon to be examined, in order to reveal opinions and views about a specific field of thought (Budden, 2017). In this study, the theoretical framework is described as a foundation from which all knowledge is constructed for a research. The theoretical framework considered relevant for this study is technological, pedagogical and content knowledge (TPACK). In order to utilise Turnitin, it is important that its users, lecturers, in this case, have the knowledge of TPACK. The following sections presents an overview of the historical antecedents of TPACK, the concept of TPACK, review of the constructs that constitute TPACK, TPACK development and teaching in mathematics, rationale for using TPACK, application of TPACK in the study, limitations of TPACK, overcoming TPACK limitations, as well as the chapter summary.

3.2 An Overview of the Historical Antecedents of TPACK

The root of TPACK goes back to Shulman's pedagogical content knowledge (PCK) principles which stress the importance of blending content and pedagogy (Pamuk, 2012). Shulman (1986,1987) asserts that, when educators utilise technology, they should have both content and pedagogical knowledge. However, Shulman was challenged by other authors to say that content and pedagogical knowledge are curriculum issues. These concerns are not sufficient without technological knowledge. For example, Alrwaished et al. (2017) argue that, not only are teachers required to understand relevant content knowledge, they also need to know how to convey this content to students. Teachers must also be able to adapt and update their technological knowledge in line with technical and lifestyle development. In recent years, the use of technology in schools has increased, as more investment has been made in computers, educational software, and similar

technology hardware (Mishra & Koehler, 2006). Initially, there was a rush to get equipment into the schools, but little or no attention was given to how the equipment would be used, or how lecturers would be trained to use it. It then became evident that simply integrating technology into the classroom activities would not be successful. Many researchers began the exploration of effective methods to integrate these technologies into the classroom, while developing viable programmes to train lecturers on these blending techniques. In view of this, Mishra and Koehler (2006) developed one of the frameworks that emerged to solve this dilemma. Furthermore, a study conducted by Mishra et al. (2010), which described a teacher-knowledge framework for technology integration was called technological pedagogical content knowledge (previously known as TPCK, now known as TPACK). This framework builds on Shulman's (1986, 1987) construction of pedagogical content knowledge (PCK). The article begins with a brief introduction to the complex and ill-structured nature of teaching. The paper reveals that Koehler, Mishra and Cain's work in 2006 outlined a new theoretical framework that they created as the technological, pedagogical, content-knowledge framework (TPACK). This theory was built per the efforts of Shulman (1986), who articulated that understanding of a content area without a pedagogical skill, is not sufficient to develop good teachers (Chai et al., 2013). Thereafter, Koehler and Mishra (2009) added technological knowledge as a primary component, to the work of Shulman (Tzu-Chiang et al., 2013). Hence, Mishra and Koehler's (2009) mode is called TPACK (Koehler et al., 2013). In the following sections, a review on the TPACK concepts is unpacked.

3.3 The Concept of TPACK

The third component of Shulman's idea is known as technological knowledge. This is referred to as ways of using technology in representation (Shulman, 1986), and plays a critical role in delivery of lessons in the classroom (Mishra & Koehler, 2006). Hence, the development of technological, pedagogical, and content knowledge framework as a teaching theory, is used in this study. In this learning theory (TPACK), there is an intersection between content knowledge and pedagogical knowledge, marked as the area in which good teaching occurred. Mishra and Koehler's work in 2006 outlined a new theoretical framework that they invented, dubbed the technological, pedagogical, content knowledge (TPCK) framework (Koehler et al., 2013). According to Mishra and Koehler (2009), teachers should not only learn the use of current teaching and learning tools, but should also learn new teaching techniques and skills as the old and current tools become

outdated. This new theoretical framework (TPACK) that added technology to Shulman's model as a connected, overlapping body of knowledge, comprises seven components, as shown in Figure 3.1 below.

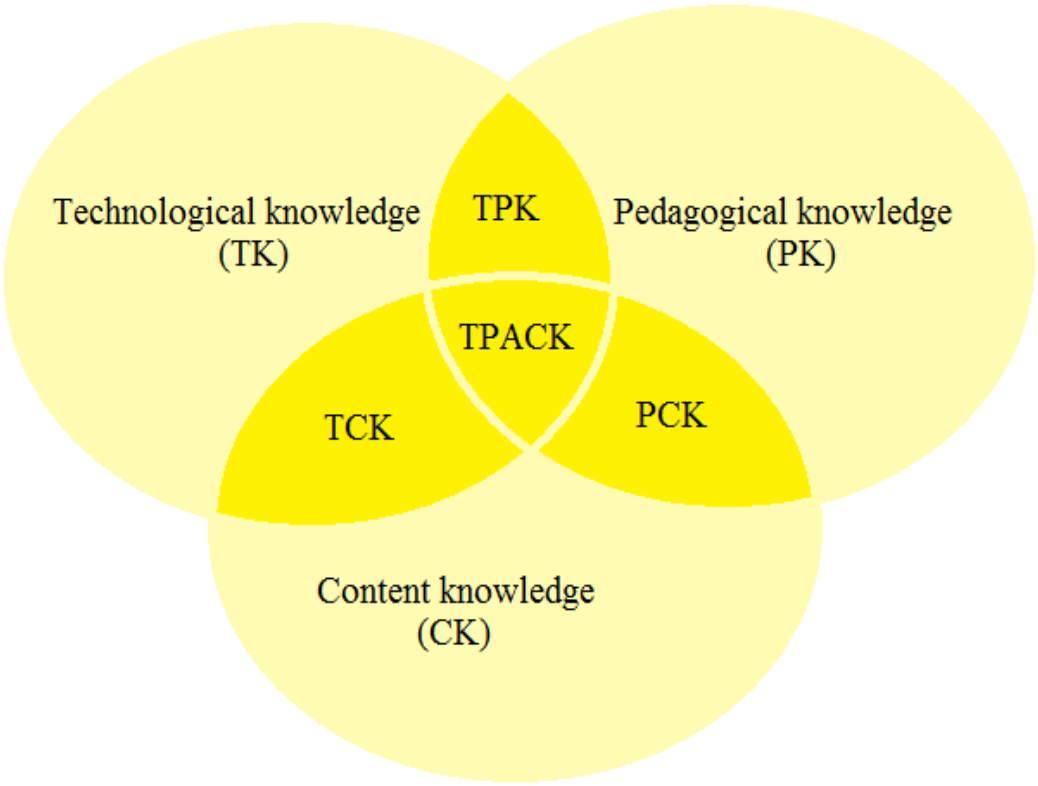


Figure 3.1: The TPACK framework and its knowledge components (Glowatz & O'Brien, 2018, p. 15)

A research carried out by Bibi and Khan (2017), which used real-life planning observations to understand James's TPACK, reveals that TPACK consists of technological knowledge (TK), content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological, pedagogical, and content knowledge (TPACK). According to them, the constructs are formed through the interaction of content, pedagogy and technology. These components guided teachers' understanding of technology integration in teaching and learning (Mogari, 2014; Niess, 2005, 2007), as unpacked. Stoltenkamp and Kabaka (2014) unveil the three components as

follows: technological knowledge (TK); content knowledge (CK), pedagogical knowledge (PK); pedagogical content knowledge (PCK); technological pedagogical knowledge (TPK); technological content knowledge (TCK); and technological, pedagogical and content knowledge (TPACK).

3.3.1 Technological Knowledge (TK)

Technology is an integral part of accessing high-level competencies, often referred to as 21st Century skills, according to Widowati (2019). A new era of technology has become more visible during the past few years (Mihyun & Jaehyoun, 2016). This technology not only refers to the use of computer or laptop, server, or network, but it also refers to the technical equipment used in one's profession of study (Hardisky, 2018). Education has been influenced by technological advancement, like other disciplines such as engineering, medicine, trade, science and agriculture (Öndeş & Çiltaş, 2018). This influence has led to the idea of consistent digitisation and the possibility of flexibly combining different business models, like education (Xing & Marwala, 2017). For instance, education is expected to fit in with economic and political trends associated with the Fourth Industrial Revolution (Xing & Marwala, 2017). A study was conducted by Mihyun and Jaehyoun (2016) examining the research done on the Fourth Industrial Revolution field, based on the article submitted to APICSIST 2015. The topics related to the Fourth Industrial Revolution were categorised on the keyword frequency of main issues. This study reveals that the Fourth Industrial Revolution is a combination of the Internet of Things, Cyber-Physical Systems(CPS) and Internet of Services collaborating with one another and with humans within a system. Within the system, industrial resolutions are related to social, economic, and technological changes, the appropriate economic and social environment being necessary for the invention and spread of technologies (Dobos, Tamás, Illés, & Balogh, 2018).

A case study sampled 90 fourth-year pre-service mathematics teachers (Öndeş & Çiltaş, 2018). The aim of the study was to make prospective mathematics teachers aware of technological pedagogical content knowledge (TPACK) by asking them to use the assessment framework in the context of TPACK components for sample geometry activities, and to identify their levels on a scale called TPACK. The findings of the study revealed that, in the classrooms and schools inside the real-life environments, technology has become a facilitator which makes students gain

knowledge and skill through the use of technology, preparing them for the future. This implies the significance of technological knowledge. Technological knowledge (TK) involves standards and advanced technologies, discussed in detail in Chapter Two. Technological knowledge (TK) is about different ways of working with technology, tools, resources, software, and knowledge application to all technology tools and resources (Koehler & Mishra, 2009). Resources vary from low-tech technologies, for example, pencil and paper, to digital technologies such as the Internet, digital video, communicating whiteboards, and software programmes (Öndeş & Çiltaş, 2018). This awareness of different technologies can be enhanced either through personal exploration such as websites, blogs, iTunes, Apps Store, as well as through formal venues like professional development and conferences (Hardisky, 2018). In addition, such professional development might equip lecturers with technological knowledge of how to operate hardware, software as well as ideological-ware (Özgün-Koca, Meagher, & Edwards, 2010). This operation might assist lecturers to stay up to date, as the new technology today may become an old in few days or years to come (Kafyulilo, 2010). Therefore, the acceptance and implementation of a new technology is similar to the process of accepting innovation (Ay, Karadag, & Acat, 2016). In return, students might understand key concepts more intuitively, and interpret technology results easily (Xing & Marwala, 2017). Therefore, technological knowledge is determined by pedagogical knowledge.

3.3.2 Pedagogical Knowledge (PK)

Pedagogical knowledge (PK) involves teachers' in-depth knowledge about the processes, practices and methods of assessment, teaching techniques, classroom management, time, lesson-plan development and implementation as well as entire educational processes (Koehler & Mishra, 2009; Öndeş & Çiltaş, 2018). Pedagogical knowledge is also about understanding cognitive, social, developmental theories of learning and how to apply these theories (Öndeş & Çiltaş, 2018). Application of theories require lecturers' pedagogical knowledge by setting dates for submissions to technology, giving students enough time to plan on their work schedule (Bibi & Khan, 2017). A study by Xing and Marwala (2017) was conducted, exploring the impact of higher education Fourth Industrial Revolution on the mission of a university that teaches research and service. Results from the study reveal that the core mission of universities is to ensure quality pedagogical knowledge to enable the student to gain the latest knowledge, sustaining the development of the university. In this view, it is necessary for universities to implement appropriate assessment

strategies; and to organise work that nurtures learning (Xing & Marwala, 2017). This describes teachers' deep understanding about the processes and methods of assessing, encompassing educational purposes, strategies, values, and aims (Alrwaished et al., 2017; Koehler & Mishra, 2009). It also suggests that pedagogical knowledge needs to be considered the frame of reference from which the instructor selects how to deliver the content knowledge in different ways (Hardisky, 2018).

3.3.3 Content Knowledge (CK)

Content knowledge involves factual content and teaching learnt or conveyed in education (Mishra & Koehler, 2006; Öndeş & Çiltaş, 2018). A study was conducted by Öndeş and Çiltaş (2018) with the aim of making prospective mathematics teachers aware of technological pedagogy (Soomro et al., 2018). The assessment framework in the context of TPACK components, for sample geometry activities, would be provided, identifying their levels by the scale known as TPACK for the geometry instrument. The findings revealed that content knowledge also includes knowledge of central facts, concepts, theories, and procedures within a specific field; knowledge of explanatory frameworks that organise and connect ideas; and knowledge of the rules of evidence and proof. In this kind of knowledge, the course content has to be covered in mathematics (Mishra & Koehler, 2006), in order to assess that particular covered content, using technology. Lecturers should understand facts and concepts of mathematics while utilising technology (Özgün-Koca et al., 2010). The teacher is required to be equipped with sufficient content knowledge to provide explanations in answer to students' queries (Soomro et al., 2018). Furthermore, content knowledge contains different assessment methods in aligning objectives of utilising technology (Soomro et al., 2018). Teachers should know the mathematical content they are supposed to teach, as well to know beyond the level they are assigned to teach (Baumert et al., 2010).

According to Bansilal et al. (2014), in South Africa, many studies suggest that mathematics teachers struggle with the content that they teach. The teacher's poor understanding of the concepts of mathematics, missing some key ideas, and presenting complicated explanations that involve circular reasoning, might make no sense to students (Bansilal et al., 2014). The higher education institutions should develop students with the knowledge of mathematics (Kafyulilo, 2010). This knowledge includes the knowledge of concepts, theories, ideas, organisational framework,

mathematical facts and theories, knowledge of evidence and proof, as well as established practices and approaches to developing content knowledge of mathematics Shulman (1986) cited in (Koehler & Mishra, 2009). Teachers should have more content knowledge in order to empower students with content knowledge required for them in the classroom. Content is always important; it should not be integrated under technology or pedagogy.

3.3.4 Pedagogical Content Knowledge (PCK)

PCK refers to the individual form of professional knowledge that lecturers possess in making the content knowledge accessible to the students per various pedagogical methods (Chai et al., 2013). Pamuk (2012) argues that the foundations of TPACK are developed based on the PCK concept; and that PCK development should be prioritised in TPACK development. A study was conducted Koehler and Mishra (2009) within a computer education and instructional technology department at a Turkish university. This study discusses pre-service teachers' achievement barriers to technology integration, using principles of technological pedagogical content knowledge (TPACK) as an evaluative framework. The study involved 78 juniors in a semester-long course, Principles of Distance Education. The findings of the study indicated that PCK implies the information of the subject matter for teaching. This covers the core business of assessment and reporting, promoting the links among curriculum, assessment and pedagogy, taking the professional understanding curve. For example, teachers examine the reports of student work from Turnitin, since Turnitin is part of assessment. Identification of reliable and relevant 21st century technologies that can be incorporated to improve lecturers' PCK, should be part of all mathematics lecturers' instructional practice (Kapp, 2015). As Bansilal et al. (2014) argue, there is a strong link between PCK and classroom practise, that allows lecturers to use various methods to deliver the content of mathematics (Alrwaished et al., 2017). In this view, it is essential to have teaching approaches that fit the content. Elements of the content can be arranged for better assessment. Teaching strategies incorporate appropriate conceptual representations in order to address students' difficulties and misconceptions and foster meaningful understanding of their academic writing (Öndeş & Çiltaş, 2018). As Koehler and Mishra (2009) contend, a highly trained mathematician would not necessarily be a great teacher of mathematics. This teacher might lack a knowledge of basic pedagogical issues, such as an understanding of students, their developmental course, misconceptions they might have, and the best way to present mathematical ideas to

individual students (Koehler & Mishra, 2009). This implies the prominence of pedagogical knowledge that is appropriate to teaching specific content in mathematics (Alrwaished et al., 2017).

3.3.5 Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge (TPK) is an understanding of how assessment can change when a particular technology is used in certain ways (Mishra et al., 2010). This refers to private understanding. In the light of the above statement, teachers need to understand how to deal with the originality of the content detected by Turnitin. Teachers must be able to read a Turnitin report and detect originality manually. Generally, lecturers need to understand how to add technology into their practice (Alrwaished et al., 2017) (professional understanding). Besides, the addition of technology to practice might display the significance of integrating technology into pedagogical practice (Hardisky, 2018). For example, the teachers might allow students to upload their texts to Turnitin. The teacher could then assess their texts through the technology, giving students feedback online. This action might assist lecturers to connect their skills via technology (Alrwaished et al., 2017). This connective use of Turnitin in assessment is essential for improving education (Widowati, 2019). Technological pedagogical knowledge also considers the effects of technology usage on the assessment process (Ay et al., 2016). Technology not only promotes or supports the conceptual and procedural understanding, but also assists in connecting these types of understanding, whereby technology not only promotes or supports the conceptual and procedural understanding, but also assists in connecting these types of understanding (Alshehri, 2012). The appropriate usage of technology might therefore change the way teachers conduct assessment (Öndeş & Çiltaş, 2018). Educators should remain true to the nature in which technology and mathematics are applied to the real-world situation (Kelley & Knowles, 2016).

3.3.6 Technological Content Knowledge (TCK)

Technological Content Knowledge (TCK) is defined as the achievement of technological content knowledge (Alshehri, 2012). It is also defined as the deep connection technology has in relation to content knowledge. Kafyulilo (2010) declares that TCK is also an understanding of the manner in which technology and content influence and constrain one another. Technology provides support for integrating content (Aparicio, Bacao, & Oliveira, 2016). According to Mudzimiri (2012),

technological content knowledge focuses on the technology used in the delivery of a specific subject, for instance, mathematics; in the case of this study, utilisation of technology in teaching mathematics content. Lecturers should have an understanding of the manner in which technology and content concepts interrelate with one another (Koehler & Mishra, 2009). Teachers should show understanding of technology by looking carefully at any report flagged by Turnitin and be able to understand the content that indicates similarity; such as mathematical equations, tables and formulae (Pamuk, 2012). Similarly, TCK can help lecturers to understand how technology can be used with mathematics to make the teaching process more effective (Soomro et al., 2018). Moreover, the curriculum and assessment are mostly designed for student teachers who are preparing to become teachers. Their syllabus involves knowledge of assessment with the assistance of technology (Saralar, Işıksal-Bostan, & Akyüz, 2017). In this view, a lecturer is capable of assessing the flagged content by Turnitin using professional understanding. Generally, implementation of TCK shows how Turnitin and content impact each other, while also strengthening each other (Alrwaished et al., 2017). The teacher with a high level of integrated technology software best presents the personal mathematics topic (Alshehri, 2012). Therefore, teachers should not only master the content, but also the manner in which the content might be changed by the use of technology (Koehler & Mishra, 2009).

3.3.7 Technological, Pedagogical and Content Knowledge (TPACK)

Effective teaching with technology requires knowledge of how technology, pedagogy and content interact with each other, meaningfully (Ersanl, 2016). A study by Setuju et al. (2018) was planned by utilising Edmodo implementation with the intention of gaining knowledge of e-learning to internalise the technology into pedagogic, instructional resources and knowledge packed in connection to e-learning. This study reveals that technological, pedagogical and content knowledge is vital for training prospective teachers to be more competent in teaching students in the 21st century. To offer this knowledge places more demand on the requirements for professional development that focus on linking content to technology and pedagogy, as well as on the various representations of technology (Ndongfack, 2015). During the procedure of assimilating technology, pedagogy, and content, teachers need to know not just the mathematics subject they teach, but the manner in which the content can be changed by the application of technology (Mishra & Koehler, 2009). This process of bringing technology into content and pedagogy to form

the pedagogical content knowledge is not easy; it is complex and thought-provoking (Kafyulilo, 2010; Koehler & Mishra, 2009). Schmidt et al. (2010) conducted a study by describing survey instrument design to assess TPACK for pre-service teachers. The purpose of the study was to develop and validate an instrument designed to measure pre-service teachers' self-assessment of their technological, pedagogical and content knowledge (TPACK). The findings of the study reveal that, to overcome these challenges, teachers must have an intuitive understanding of the complex interplay between the three basic components of knowledge (CK, PK, TK) by teaching content using suitable pedagogical methods and technologies, indicating personal understanding. The involvement of policymakers and stakeholders to identify the needs, comprehensive professional development programmes for elevating the qualities of teaching and learning, need to be considered (Alrwaished et al., 2017).

3.4 TPACK Development in Mathematics

The developmental process of TPACK consists of various stages. A study conducted by Mudzimiri (2012) proposed using three courses on pre-service teachers that were offered in collaboration, a mathematics teaching methods course, a technology-intensive content-rich mathematical modelling course, and a practicum course, to study the development of connections between technology, content and pedagogy. This study reveals that there are five stages for the development of TPACK in mathematics. It was found that, for the development of TPACK in mathematics, the teachers should go through five stages, namely**:** Recognizing (knowledge), Accepting (persuasion), Adapting (decision), Exploring (implementation) and Advancing (confirmation) (Kafyulilo, 2010; Kapp, 2015; Mudzimiri, 2012; Ndongfack, 2015; Niess et al., 2009). Figure 3.2 below shows the stages that teachers had to go through in order to effectively integrate technology into teaching.

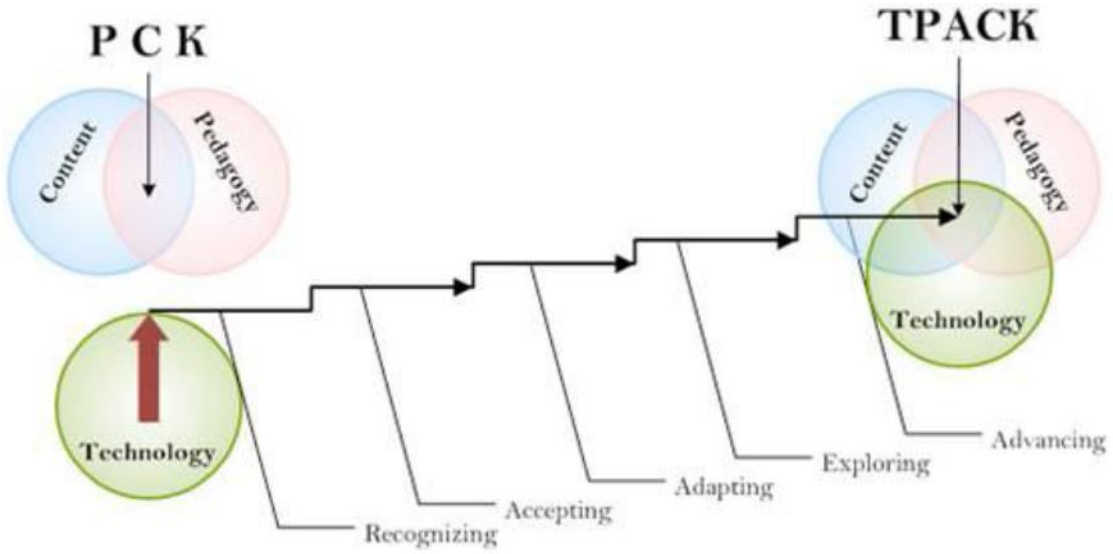


Figure 3.2: TPACK development stages (Niess et al, 2009, p. 10)

Figure 3.2 portrays levels in which teachers engage as they develop their knowledge and understandings so that technology, pedagogy, and content knowledge bases emerge (Kafyulilo, 2010; Ndongfack, 2015; Niess et al., 2009). The authors further unpack the graphic as follows: On the left side of the graphic, the figure highlights PCK as the intersection of pedagogy and content. Then, as knowledge of technology enlarges and starts to intersect with pedagogy and content knowledge, the teacher-knowledge base that transpires is the knowledge described as TPACK. This is where teachers actively engage in guiding students' learning of mathematics with appropriate technologies.

Recognising the stages of TPACK development is where teachers begin to utilise simple technology, as well as realising their capability in improving instruction methods in mathematics (Ndongfack, 2015). In the same vein, Niess et al. (2009) assert that, at the phase where teachers are capable of utilising the technology and recognising the alignment of the technology with mathematics, they do not incorporate the technology into teaching and learning of mathematics. The moment teachers realise the benefits of utilising technology, they start to integrate it in assessing mathematics, which is an accepting stage (Ndongfack, 2015). As teachers accept the benefit of technology, they engage activities that lead to a choice either to familiarise themselves with, or reject teaching and learning mathematics with suitable technology (Kafyulilo, 2010). At

this stage, it depends on the teacher's decision and experience whether to adopt technology software to assess mathematics (Alshehri, 2012). Furthermore, the adopting stage leads to the exploring stage; teachers are engaged in exploring their depths of prior knowledge during teaching (Kapp, 2015). Teachers then need to clearly understand the benefit of teaching with technology (Alrwaished et al., 2017). They may well be capable of integrating technology during assessment of mathematics (Alshehri, 2012). Moreover, teachers will be able to explore other developing methods for technology implementation, as remarked by Hardisky (2018). The implementation (advanced) stage assists lecturers to evaluate the results of integrating mathematics teaching and learning with appropriate technology (Kafyulilo, 2010).

The reviews above provide the standard and model-structured details to further the work of various groups (Niess et al., 2009). The mathematics teacher's knowledge of technology integration in teaching and learning offers guidelines for thinking about the construct called TPACK. As revealed, the above-mentioned teacher's stages in thinking and understanding in the process of the development of TPACK is framed by curriculum, assessment, content, teachers, procedures, as well as resources. These mentioned concepts are discussed in detail in Chapter Two. In every subject curriculum, concepts are the backbone in teacher education during the development process. Therefore, were the curricular concepts to be considered as whole, there might be an improvement in the teachers' knowledge during the developmental process (Niess et al., 2009; Saralar et al., 2017).

3.5 TPACK in Teaching and Learning of Mathematics

TPACK in mathematics may not be the same as TPACK in other subjects (Mudzimiri, 2012), owing to its own culture. Kafyulilo (2010) proposed the adoption of information communication technology (ICT) in science and mathematics teaching, as an alternative method for improving teaching and learning in science and mathematics. The focus of the study was more on the use of ICT in education which refers to the instructional use of computers, television, and other electronic resources. This study found that technology integration in teaching mathematics requires teachers' understanding of the content they want to teach, the pedagogy which is concurrent with the content to be taught, and the technology that can support students' learning within a certain context. Integrating these types of knowledge through the development of TPK and TCK and TPACK

might give lecturers a more holistic view of their teaching. Such integration could help them in the transition from students of mathematics to lecturers of mathematics (Özgün-Koca et al., 2010), showing personal understanding. In accordance with Niess et al. (2009) and Özgün-Koca et al. (2010), as technology changes, so teachers, students, and the classroom context change. TPACK offers a dynamic framework for reviewing teachers' knowledge. According to Niess et al. (2009), this knowledge is necessary for the design of the curriculum and instruction, focused on preparation of students' thinking and learning mathematics with digital technology (personal understanding). The mathematics teacher plays a significant role in engaging students while learning mathematics. In this case, university staff have a responsibility to dig deep into mathematics discipline to study TPACK and pay attention to the TPACK of mathematics teachers (Haung, 2018). This might assist future teachers to better implement the national will, and promote their insight into the subject of education, becoming cultivated digital mathematics teachers (Haung, 2018). If teachers are developed, they might be able to rethink the pedagogical strategies for mathematics for the better learning of students. A sufficient level of TPACK enables the mathematics teacher to appropriately select and use the innovative pedagogical strategies, such as a demonstration of concrete and virtual manipulatives, a flipped classroom approach, dynamic mathematics software, as well as animated content demonstration in mathematics (Arora & Pany, 2018). Similarly, if teachers are encouraged to think openly about technological pedagogical content knowledge, and to develop metacognitive awareness of their professional knowledge, this leads to positive changes in their teaching practice (De Freitas & Spangenberg, 2019). To buttress this, a study which focused on the change in teaching practice from traditional teaching to technological teaching, was conducted by Hill and Uribe-Florez (2020) in a rural public school district in the mid-Atlantic region of the United States. The study explored the TPACK of middle and high-school math and special education teachers, and how they integrated technology in their mathematics classroom. With a mixed-methods design employed, data were collected to measure teachers' TPACK through seven open-ended questions regarding technology integration. The findings from this study reveal that most teachers believe that using technology makes mathematics more enjoyable for students. Technology helps students in gaining deeper understanding of mathematics and solving real-world problems. Such teachers indicate a positive attitude towards technology integration and a willingness to learn and grow (Hill & Uribe-Florez,

2020). Technology must therefore be easily accessible and available for teachers (Voogt, Fisser, Tondeur, & van Braak, 2015).

Although the technology presently available is accessible and easy to use, its application to teaching and learning may be complex. The emphasis on the development of TPACK is therefore believed to be crucial in education programmes (Gonzalez & González-Ruiz, 2017) (professional understanding). Students rely on lecturers' knowledge and understanding to provide the best assessment (Alrwaished et al., 2017). This suggests the need for courses about technology integration in mathematics education (Durdu & Dag, 2017). Lecturers must have a profound understanding of mathematics content; recognising the instructions and methods that must be applied in the students' work, according to the differences in their abilities. The best Turnitin software must be engaged while making assessments (Alrwaished et al., 2017).

Based on the above literature, the key to TPACK is the integration of multiple domains of knowledge in a manner that will support lecturers in assessing their students with Turnitin as an aid (van den Akker et al., 2009). If lecturers integrate knowledge of technology, pedagogy and content, they bring TPACK into play (Mishra & Koehler, 2006). This statement is in accordance with Pamuk (2012), who states that TPACK is introduced into the educational research field as a theoretical framework for understanding teacher knowledge required for technology integration. The conceptual framework gives teachers a more holistic view of their teaching, and helps them transit from learners of mathematics to teachers of mathematics (Özgün-Koca et al., 2010). Mathematics teachers with higher TPACK confidence are likely to have explored with their students a greater breadth of activities related to 21st century skills (Drajati, Tan, Haryati, Rochsantiningsih, & Zainnuri, 2018). It is believed that this form of confidence motivates mathematics teachers' attitude towards applying technology in the classroom (Gonzalez & González-Ruiz, 2017). Several studies have been conducted to authenticate and validate the TPACK framework in mathematics. Most of these were conducted only on teacher educators or on pre-service teachers (Soomro et al., 2018). Therefore, there is a need for a study to be conducted on lecturers' understanding of a TPACK framework in mathematics. This leads to the conclusion that, although TPACK is reported to enhance learning in mathematics, teachers are not yet integrating it into their teaching (Kafyulilo, 2010).

3.6 Rationale for Using TPACK

TPACK involves integration of technology, pedagogy, and content. This study is about integrating technology in assessing mathematics by utilising Turnitin. The concepts discussed in TPACK are in line with the phenomenon of the study. A study focused on how the TPACK construct was understood. The study was conducted on K-12 seven schools and districts organisations (Harris & Hofer, 2017). The study results reveal the importance of context and professional culture in appropriating the construct; the use of TPACK as a way of connecting various professional development initiatives; TPACK conceptualised as applied knowledge; and how educational leaders' belief about professional development shapes how TPACK is understood and enacted. In this study, TPACK is described as a three-legged chair; technology, content, and pedagogy are legs, therefore, they are the foundation on which all digital mathematics should be presented. It was further revealed in this study that if one component is not complete, and one is not rock solid, the chair will fall. In addition, a survey study conducted by Tzu-Chiang et al. (2013) explored perceptions of the technological pedagogical content knowledge (TPACK) on 222 pre- and in-service science educators in Singapore. The findings of the study indicate that these authors agree that TPACK might serve as a suitable framework for bridging teacher education and educational technology. In this light, TPACK is a suitable framework for linking the content and pedagogy with technology. For example, applying dynamic geometry software (GeoGebra) to the mathematics lessons shows an understanding of how TPACK is used (Öndeş & Çiltaş, 2018).

This framework also serves as the structure and support for the rationale for this study, the purpose, the significance, and the research questions (Grant & Osanloo, 2014). The purpose of the study is to explore lecturers' understanding of Turnitin utilisation at a South African university. The research may be significant to some lecturers, especially to the participants, by assisting them to reflect on their current practices, and perhaps the level of support provided to students within universities on utilisation of Turnitin. The results of the study might also benefit the higher education institutions, policy developers and policymakers utilising Turnitin to revise policies that might benefit both lecturers and students. The research questions are as follows:

1. What are lecturers' understanding of Turnitin utilisation in assessing mathematics at a SA university?

2. How do lecturers understand utilisation of Turnitin in assessing mathematics at a South African university?

3. Why do lecturers understand utilisation of Turnitin in assessing mathematics in particular ways at a South African university?

TPACK is a suitable theoretical framework for this study. However, it is the duty of the researcher to ensure that the chosen theory is aligned with, and supports the structure of the study's purpose, the significance, and the research questions, as well as the design (Grant & Osanloo, 2014). The framework TPACK as adopted, is suitable for this study. In view of this, a study examined the perception and implementation of pre-service teachers and in-service teachers apropos of literacy on the three aspects, namely, technology, pedagogy, and content (Drajati et al., 2018). The study employed qualitative research design. The authors generated data using a questionnaire answered by 100 pre-service teachers and in-service teachers. The study reveals that the TPACK framework is needed for teachers to improve the three most important points of technology, knowledge, and content in supporting one another and engaging students' achievement. Students' achievement comes about through the balance of mathematics, pedagogy and adoption of digital technologies, taking the context into account (Salavati, 2016). This includes knowledge of student thinking and learning, knowledge of subject matter, and increasingly, knowledge of technology (Koehler et al., 2013). These authors further state that this inclusion seeks to assist the development of better techniques for discovering and describing how technology-related professional knowledge is employed and initiated in practise (Koehler et al., 2013).

Moreover, a study conducted by Voogt and McKenney (2017) examined whether and how five teacher-education institutes are helping students to develop the technological content knowledge needed to effectively use technology for early literacy. The study used focus-group discussions with teacher educators, in which their responses to expert recommendations were probed. Results from the study indicate that, currently, very little attention is specifically given to the knowledge that a teacher needs, to foster early literacy in the application of technology. Furthermore, the study reveals that TPACK is a useful conceptual framework for clarifying the kind of knowledge teachers need in assimilating technology in their teaching. TPACK is also the basis for effective teaching with technology, requiring an understanding of the representation of concepts using

technologies; also pedagogical techniques that use technologies in constructive ways to teach content, and knowledge of what makes concepts difficult or easy to learn (Koehler et al., 2013; Mishra & Koehler, 2009). Technology can help rectify some of the problems that students face, offering students' prior knowledge and theories of epistemology; also knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or to strengthen old ones (ibid). In the same argument, Gonzalez and González-Ruiz (2017) declare that TPACK is regarded as necessary to the effective application of technology in teaching. These authors further argue that TPACK highlights the integration of the content to be transmitted, the respective teaching processes and the use of technology in this context. In this context, the TPACK framework outlines an interaction between content, pedagogy, and technology, which yields the category of flexible knowledge essential to integrating technology into teaching (Glowatz & O'Brien, 2017). In addition, the interaction between content, pedagogy, and technology generate the type of flexible knowledge for successfully integrating technology into teaching (Glowatz & O'Brien, 2017).

Based on the above literature, TPACK is in the driver's seat in teaching and learning; there should be a balance between content, pedagogy, and technology in the era of the 21st century. As there is a shift towards the Fourth Industrial Revolution, teachers have no choice but to familiarise themselves with the TPACK conceptual framework in their teaching and learning. As Bullock (2019) points out, the more teachers utilise technology, the more students will use it and become comfortable with using technology as a learning tool to assist them in being successful. TPACK has the potential to offer a strong foundation for future technology integration. It also provides theoretical guidance for how teacher education programmes might approach training of candidates who can utilise technology in content-specific areas, as well as in general ways (Jwaid, 2016). Therefore, while teachers and students use digital technologies, they need support to understand the effective use of it in teaching practice (Ravanelli, 2019). Training in technology is important and should be provided by universities in order to adequately use technology to promote teaching (Garrett, 2014). This indicates the importance of TPACK application.

3.7 Application of TPACK in the Study

Teaching in higher education relies on pedagogical and content knowledge. The incorporation of technological knowledge and technological, pedagogical, and content knowledge (TPACK) have had an influence on the educational framework (Jwaid, 2016). Özgün-Koca et al. (2010) suggest that experiencing success in document analysis, questionnaires, or interviews are vital elements in the development of TPACK. Therefore, the data that will be generated from the reflective activity, one-on-one semi-structured interviews, and document analysis from this study will be used for the development of TPACK. In addition, the objectives of the study are framed around the TPACK framework. The objectives of the study are:

- To explore lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university.
- To understand lecturers' understanding of Turnitin utilisation in assessing mathematics at South African university.
- To understand the reason for the lecturers' understanding of Turnitin utilisation in assessing mathematics per Turnitin at a South African university.

Moreover, Gonzalez and González-Ruiz (2017) declare that TPACK is regarded as a necessity in the effective application of technology in teaching. These authors further argue that TPACK highlights the integration of the content to be transmitted, the respective teaching processes, and the use of technology. In this context, TPACK is the embodiment of pre-service teachers' and in-service teachers' prior content knowledge and theories; knowledge of how technologies can be used to build on existing knowledge and to develop new theories (Koehler, 2009). The study conducted by Arora and Pany (2018), reveals that, for an effective teaching-learning process, a balanced knowledge of three components is expected on the part of teacher; that is, an adequate level of technological pedagogical and content knowledge. The conventional pedagogies need to be strengthened through the application of technology. Rahman, Krishnan, and Kapila (2017) conducted a study on twenty educators at eight urban, inner-city schools, watching their instruction of robotics-focused STEM teachings within the TPACK framework. The study explored the dynamic nature of TPACK for teaching STEM with robotics in middle-school classrooms, using questionnaires identifying the ideal requirements of teachers' TPACK to effectively teach STEM lessons using robotics. Also determined was the relative importance of the various domains of

TPACK, using questionnaires and brainstorming identifying the factors that may affect the requirements of the technological, pedagogical, and content knowledge, and their relative importance. The study investigated various strategies and awareness levels of TPACK in different schools. The findings of the study declare that the implementation of TPACK framework can generate its three main knowledge components supplementary to one another. Rahman et al. (2017) further emphasise that educators must utilise TPACK to be competent teachers. Teachers must obtain content knowledge of their discipline, pedagogical knowledge in order to be successful in transmitting their knowledge to students, and the knowledge to implement suitable educational technologies in their instruction practice.

According to Alrwaished et al. (2017), not only are teachers required to understand relevant content knowledge, they also need to know how to deliver this content to their students. Teachers need to adapt and update their technological knowledge to keep up with technical and lifestyle development. This study was conducted to develop and apply a framework that captures some of the essential qualities of the knowledge-enhanced educational environment using technology and pedagogy content knowledge (TPACK). A TPACK Short and Quick (TPACK-SQ) survey questionnaire was used to explore and assess 224 pre-service and in-service science and mathematics teachers in Kuwait. Furthermore, the concept of TPACK is leading a new direction for integration of information technology (Haung, 2018). Haung (2018) further states that teachers should be encouraged to recognise that the application of information technology might provide help for the teaching knowledge and content knowledge. Teachers should willingly and actively seek the development and exploration of this teaching mode. A study was conducted in South Africa by De Freitas and Spangenberg (2019) on ninety-three (93) mathematics teachers, aiming to identify mathematics teachers' level of TPACK, and barriers to integrating information and communication technology (ICT), as a means to inform their continuous professional development needs. This study used the TPACK framework of Mishra and Koehler as a lens for the study, utilising both quantitative and qualitative research methods. The study used a quantitative questionnaire, reporting higher levels of content, pedagogical, and pedagogical content knowledge, with comparatively lower levels of technology, technological pedagogical, and technological content knowledge. Results of the study reveal that South African teachers are willing to learn new ways of making teaching and learning interesting, through TPACK. South

African universities have to play a huge role in developing student teachers, so that when they graduate, they are competent to implement TPACK knowledge in schools. In addition, training and adaptation of technology should be implemented in projects and applications, so that future teachers are more competent in developing TPACK and material (Karakaya & Yazici, 2017). Teachers who are recently from universities are expected to apply their acquired TPACK and related skills in real classrooms, as they seem to have a sufficient level of TPACK by their final year in the faculty of education (Karakaya & Yazici, 2017). In accordance with this statement, a case-study methodology was conducted by Baran and Uygun (2016) on ten (10) graduate students through reflection reports, design guides, and researcher observation notes. The study examined how course activities facilitated understanding of TPACK-in-action; and to what extent students enacted TPACK design-based learning (DBL) principles. This study reveals that, while students are in higher education, they should be engaged in designing activities to explore TPACK. Such engagement empowers them to develop an understanding of TPACK-in-action across four dimensions, namely, TPACK theory and practice connection, readiness for practice, technology proficiency, and sustainable learning of TPACK. These dimensions could assist students as they implement TPACK in the teacher-education context while they are guided by teacher educators (Baran & Uygun, 2016). Teachers are trained with the necessary competence before ready to be in the field of teaching (Çetin & Erdoğan, 2018).

As teachers are gradually experimenting with technology, and continuing to use applications that prove effective, they learn to faultlessly intertwine technology into teaching, by planning ahead or using it spontaneously to meet learners' needs (Anderson, Grifith, & Crawford, 2017). However, bringing the necessary technology into educational settings does not guarantee effective teaching and learning (Baturay, Gökçearslan, & Sahin, 2017). In general, it is not enough to know only the technology, pedagogy, and content concepts. It is also important to have the ability to explain the structure of the concepts within that domain (Karakuş, 2018). TPACK presents a framework on knowledge teachers must have to integrate technology into their teaching and learning (Karakuş, 2018).

Based on the above studies, South African teachers are still behind in terms of the integration of technology into their teaching practice. According to Karakuş (2018), teacher knowledge is one of

the most significant factors relating to the quality of teaching. Thus, a study was conducted by Çetin and Erdoğan (2018) on 453 elementary and secondary school pre-service mathematics teachers. The purpose of the study was to develop a valid and reliable measurement tool that can be used to determine the technological pedagogical content knowledge efficiency of mathematics teacher candidates. The study used SPSS and AMOS programmes for statistical analysis, since the conceptual framework of TPACK was obvious. The scale items were written around this existing frame in TPACK sub-dimensions, and for that reason only confirmatory factors analysis was performed on the predetermined factors. The findings of this study declare that the quality of the teacher is the main contributing factor to making the education system successful or unsuccessful. In today's knowledge society, this is one of the most important proficiencies − that the teacher has good knowledge of the field and pedagogy, as well as being able to apply the technology effectively in learning situations (Çetin & Erdoğan, 2018).

This suggests that more specific strategies to promote technology integration in special education contexts require to be developed (Anderson et al., 2017). This development assists in understanding the connection among three different components involved in effective teaching and learning with technologies (Bingimlas, 2018). This also suggests that effective teaching and learning needs more practical opportunities to be facilitated for pre-teachers at education faculties, to prepare them for 21st century schools (Altuni & Akyıldız, 2017). TPACK is a complex knowledge framework, and integration of technological knowledge with content knowledge, and pedagogical knowledge comprises several factors, such as teaching themes, and the teaching methods of teachers reflecting on teaching experience knowledge (Haung, 2018). Therefore, while using digital technologies, teachers need support and specific scaffolding to understand effective use of such in their teaching practice (Ravanelli, 2019). Conversely, TPACK has its own limitations.

3.8 Limitations of TPACK

In practice, TPACK knowledge domains may not necessarily provide evidence as they are conceptualised in the literature (Bibi & Khan, 2017). In accordance with this statement, a study was conducted by Pamuk (2012). The study employed participatory informal observation, in which 78 pre-service teachers were allowed to choose content subject matter they would like to teach,

using technology. The results of the study indicate that the participants planned and reported some promising ideas and approaches for technology usage. However, in practise, the participants failed to implement their ideas and approaches in the project. Generally, it is difficult to strike an equilibrium between technology, pedagogy, and content, without the development of TPACK (Cai, 2016). In addition, while TPACK acknowledges the significance of integrating technology in the educational environment, the model does not address the need to ensure that faculty have the resources, skills, and knowledge at their disposal. Such resources would ensure competence and effective online course development and implementation (Espinoza & Neal, 2018). Furthermore, the TPACK model lacks attention to context, ignoring the value of teachers' experience, teaching style, and philosophy (Espinoza & Neal, 2018; Lewthwaite, Knight, & Loney, 2015). This suggests that there is no single technological solution applicable for every teacher, every course, or every view of teaching (Pamuk, 2012). There are various levels of disconnect between the knowledge and practise of combining ICT, content and teaching (Reyes, Reading, Doyle, & Gregory, 2017). Therefore, there is much work that needs to be done to bridge the disconnection between technology, pedagogy, and content. (Reyes et al., 2017).

The generated literature indicates that there is no guarantee that integration of technology, pedagogy, and content is implemented effectively in the teaching practice. Overcoming the drawbacks of TPACK relies on contextual factors such as accessibility of technological resolutions, the students being used to the software, and lecturers' instructional perception (Chai et al., 2013). These factors can be recognised and addressed through a more intentional adaptation of context (Espinoza & Neal, 2018). In this light, contextual factors are acknowledged to influence the practice of teachers, and this dynamic is also acknowledged by TPACK (Glowatz & O'Brien, 2018). According to Graham (2011), TPACK would be required in every teaching situation because one does not normally teach without using TPACK. This model has been widely used to describe the knowledge possessed by effective teachers (DeSantis, 2016). The knowledge possessed might be obtained from the improved lecturers' level of teaching and integration of technology to positive benefits in relation to competences, beliefs and attitudes for students (Reyes et al., 2017). The more teachers improve their understanding of technological knowledge, the more integration of technology become useful (Bruner-Timmons, Nistor, & Stanciu, 2018). Universities should play a huge role in developing teachers' knowledge on how to integrate

TPACK into teaching and learning. Hence, higher education institutions might help fill the gap on how teacher educational leaders may lead and support TPACK initiatives. This would ensure that students graduate with the knowledge and skills to effectively integrate technology into teaching and learning of mathematics (Graziano, Herring, Carpenter, Smaldino, & Finsness, 2017). Poor integration of TPACK is caused by poor technological knowledge among teachers, unavailability of technological tools, and teachers' lack of motivation to use ICT in teaching (Kafyulilo, 2010).

3.9 Overcoming TPACK Limitations

In order to shift from teaching technology to using technology, lecturers should be prepared to see technology as part and parcel of their daily lecture activities (Kafyulilo, 2010) . According to the findings of the study by Hardisky (2018), the shift to using technology would be successful if professional development deepens lecturers' teaching of a particular concept, helping them create instructional conditions conducive to student engagement, and fostering student learning of content. Undertaking the five development stages of TPACK − recognizing (knowledge), accepting (persuasion), adapting (decision), exploring (implementation) and advancing (confirmation)−can serve as appropriate framework that bridges teacher education and educational technology (Hardisky, 2018; Kafyulilo, 2010; Kapp, 2015; Mudzimiri, 2012; Ndongfack, 2015; Niess et al., 2009). In addition, lecturers can develop their educational knowledge by conducting research on TPACK (Baran & Uygun, 2016). Furthermore, it is important to receive systematic training and to be equipped with content, pedagogical, and technological knowledge, as well as to be constantly developing TPACK in the teaching process (Cai, 2016). This teaching process increases the level of preparation of mathematics teachers through educational technology resources; and supports institutions that align with the TPACK (Alshehri, 2012). The alignment with the knowledge of TPACK in lecturers could boost the performance of the student in a positive way (Alshehri, 2012). Moreover, lecturers have no problem with collaborating in teaching; and they are also open to the technology. If there is a technological infrastructure, teachers can employ TPACK in an effective manner (Soomro et al., 2018).

Based on the literature above, a move from traditional teaching to technology integrated into content teaching requires professional development of lecturers. Adequate infrastructure is required to employ technological, pedagogical, and content knowledge in an appropriate manner.

In the same view, a descriptive study of Saralar et al. (2017) was conducted on a pre-service mathematics teacher's technological pedagogical content knowledge (TPACK) during her school experience. The focus of the study was how the participant taught different views of three-dimensional objects in a private middle school. In this descriptive study, data was collected using semi-structured interviews, observations, lesson plans, and corresponding GeoGebra. The study reveals that courses designed to prepare teachers to teach mathematics with technology impart various strategies. Suitable skills for technologies are provided, while instruction on mathematics notions improves teachers' TPACK. The study further indicates that teachers' concept improvement is through the approach that combines mathematical technology, pedagogy and content, instead of teaching them as separate aspects. However, Koehler and Mishra (2009) add that the skills, competencies, and knowledge of the TPACK framework require lecturers to go beyond their knowledge of mathematics, technology, and pedagogical techniques.

To overcome the limitations of TPACK, there is a need for training and professional development afforded by TPACK that provides a rich example of how to support the implementation of some essential elements of the TPACK model (Alrwaished et al., 2017). In order to support teacher educational leaders who are teaching mathematics, mathematics lecturers must be supported in their implementation of technology. Their knowledge of technology, pedagogy, and mathematics content should be understood, as well as their methods on and perceived barriers to technology (Hill & Uribe-Florez, 2020), to avoid poor integration of TPACK.

3.10 Summary

This chapter gives an overview of theoretical framework technological, pedagogical, and content knowledge (TPACK), which is the foundation of this study. It also explains an overview of the historical antecedents of TPACK. In addition, the components of TPACK, namely, technological, pedagogical, and content knowledge, and the intersection between the three components, were discussed. This chapter necessitates the importance of involving technology, pedagogy, and content in teaching and learning, which requires lecturers to know, use, and adapt to the new emerging TK like the use of Turnitin during assessment. Secondly, the PK signal is about the methods of assessment utilising Turnitin which may be used to detect plagiarism which indicate personal understanding. Thirdly, CK is regarded as the knowledge about the subject to be taught

and learned. Lecturers should be ashored with the knowledge of mathematics that addresses professional understanding. In other words, this signal requires lecturers to be specialists in their disciplines. Forth, PCK is based on the knowledge of curriculum, teaching theories, assessment strategies and content. This implies that lecturers need to arrange their content which is in line with their assessment strategies. This is informed by personal and professional understanding. Fifth, signal is the TPK which indicates that lecturers should seek to have a skill of using technology accordingly during assessment process. These skills might assist lecturers to connect their skills via technology in order to improve education standard. This signal is driven by personal and professional understanding. In relation to the above, TCK is about the link between technology, content and assessment and how this linkage influences one another. Lastly, TPACK framework seeks lecturers to have a clear understanding of technological, and content knowledge in order assess effectively. This framework might benefit students connecting prior knowledge to the new knowledge.

Furthermore, the domains of TPACK is strengthened through application of technology during teaching, learning and assessment, which might provide help for teaching and content knowledge. This knowledge lies on South African universities to play a huge role in developing lecturers, so that in turn lecturers develop students to be competent to implement TPACK knowledge in schools. This indicates TPACK is a useful conceptual framework for clarifying the kind of knowledge lecturers need in assimilating technology in their assessment of mathematics. It may also be seen that each component supports lecturers in the assessment of students' work, while utilising Turnitin. This concludes that TPACK seek for lecturers understanding of all TPACK concepts in order to improve and have direction during assessment process. The next chapter presents in detail the procedure used to conduct the study. This chapter explorers the paradigm that guides this study, namely, the interpretive paradigm, by means of a qualitative case study. The chapter includes data generated and data-analysis methods that assist in responding to the study's questions in detail.

CHAPTER 4: RESEARCH DESIGN AND METHODS

4.1 Introduction

This study is structured to show how the exploration was done, in order to answer the research questions. These questions are: What is lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university? How do lecturers understand utilisation of Turnitin in assessing mathematics at a South African university? and Why do lecturers understand utilisation of Turnitin in assessing mathematics in particular ways at a South African university? To address these questions, first, the study explored lecturers' understanding of Turnitin utilisation. Second, its main focus is on how lecturers interpret and respond to their lived understanding of the use of Turnitin. In the previous chapter, a review of related literature on lecturers' understanding of Turnitin utilisation and the theoretical framework that underpins the study were presented. This chapter then explores the designs and methods on which the research work is grounded. The study paradigm (interpretive), research site (case study), sample and sampling technique, instruments for data generation, as well as method of data analysis are discussed. The chapter concludes with a discussion on issues of trustworthiness, ethical considerations, and limitations of the study (McMillan & Schumacher, 2014).

4.2 Methodology and Research Methods

A methodology refers to a model on which to conduct a research within the context of a particular paradigm (Wahyuni, 2012). Antwi and Hamza (2015) state that methodology signifies how the researcher goes about in practice finding out whatever he or she believes can be known. This includes the underlying sets of beliefs that guide a researcher to select one set of research methods over another (Wahyuni, 2012). The two major and most popular forms of research are qualitative methodology, which is grounded on an interpretivist paradigm, and quantitative methodology, which is grounded on a positivist paradigm. These methodologies guide the works of the vast majority of researchers in the social sciences. Social sciences scholars in South Africa use research methods in advanced ways in order to respond to the diversity present within the country's population; as well as to the distinctive contextual situations in which we find ourselves (Kramer, Fynn, & Laher, 2019). Hence, researchers should have a clear understanding of the philosophical argument guiding their research study. A study of Almalki (2016) investigated the integration of quantitative and qualitative data in mixed-methods research, and whether, in spite of its challenges,

such could be of positive benefit to many investigative studies. This study introduces the topic, defining the terms with which the subject deals; and undertakes a literature review to outline the challenges and benefits of employing this approach to research. This study reveals that there are three distinct approaches to connecting research, namely; quantitative, qualitative, and mixed methods. Corroborating Almalki (2016)'s study, Rahi (2017) remarks that, even though the quantitative and qualitative methods are regarded as the most dominating methods, the supporters of a pragmatic paradigm believe that true knowledge can obtain by a mixed-methods approach. In the following section, a review of these designs are presented, beginning with the quantitative method.

4.2.1 Quantitative research method

Quantitative method is a scientific method which is grounded and personalised with a positivist paradigm (Rahi, 2017). The goal of many quantitative education studies is to produce valid and replicable findings that add to our knowledge and understanding in ways that improve subjects' outcomes (Abulela & Harwell, 2019). Similarly, the quantitative strategy works on objectives measuring ring through actions and opinions, which help the researcher to describe the data (Rahi, 2017). In addition, quantitative strategy describes the world in numbers and measures (Thanh & Thanh, 2015). In general, a quantitative method is concerned with attempts to quantify social phenomenon, collecting and analysing numerical data (Antwi & Hamza, 2015). Likewise, quantitative research intends to make casual inferences concerning two or more variables of interest (Swart, Kramer, Ratele, & Seedat, 2019). In this method, quantitative data may be utilised in a way that supports or expands upon qualitative data, effectively enriching the description (Mackenzie & Knipe, 2006). These descriptions follow the confirmatory scientific method whose focus is on hypothesis and theory testing (Antwi & Hamza, 2015). Quantitative researchers consider the quantitative research approach to be of primary importance in stating one's hypotheses and then testing such hypotheses with empirical data to see whether they are reported (Antwi & Hamza, 2015). In this quantitative research approach, the researcher examines significance, which allows the researcher to gain a level of confidence in the results of the study (Jamilakhon, Singh, Subramaniam, & Suppramaniam, 2020). These results are obtained by subdividing the reality into smaller, manageable pieces, for the purposes of study, so that this reality can be understood (Almalki, 2016). It is within these smaller subdivisions that hypotheses

can be tested and duplicated with regard to relationships among variables (Almalki, 2016). Moreover, quantitative researchers attempt to hold back the factors that are not being investigated (Antwi & Hamza, 2015). This process of investigation entails the formulation of hypotheses developed from the researcher's conceptualisation of a particular phenomenon. Hypotheses are verified or refuted by the observed effects (Holden & Lynch, 1998).

4.2.2 Qualitative research method

The qualitative method, according to Creswell (2013), is used to find the meaning of the phenomenon, from the view of the reseach. Hakim (2000) qualitative approach is used for examining studies leading into more organised studies. A study was conducted by Rahi (2017), aimed at contributing to a detailed systematic review on research paradigms, sampling, and instrument-developing issues in the field of business research. This study has explored the levels of theory and their implications for academic literature, with agreement on this method of quantitative and qualitative research that has been discussed. This study discloses that the qualitative method is used to generate the in-depth details on a particular topic. Therefore, this study adopted a qualitative approach for exploring lecturers' understanding of Turnitin utilisation, to conduct a more organised study. In addition, qualitative research is usually related to a specific kind of data, such as words, rather than numbers (McMillan & Schumacher, 2010). As a result, more than one data-generation technique was used in applying multiple methods to analyse data using non-numerical procedures, in order to answer the research question (Rivombo, 2014). During data generation, with this research method, people were treated as research participants (Tuli, 2010). However, the researcher may also use a mixed-methods approach.

4.2.3 Mixed research method

Mixing means either the qualitative and quantitative data are actually merged at one end of the sequence, kept separate on the other end of the sequence, or combined in some way between the two extremes (Creswell, 2009). Mixed research involves the mixing of quantitative and qualitative research-method approaches (Antwi & Hamza, 2015). This mixed-methods research is widely utilised by researchers as a pragmatic method for conducting research into education (Mahato, Angell, van Teijlingen, & Simkhada, 2018). The initial stage of this research is to think carefully about the research questions, purposes, paradigmatic views, and contexts, to decide on the

appropriateness of a mixed-methods approach (Venkatesh, Brown, & Sullivan, 2014). According to Antwi and Hamza (2015), in mixed research, it is important to understand both the subjective, inter-subjective, and objective realities of our world. Antwi and Hamza (2015) further state that, although one must not influence or bias what is being observed, the insiders' meanings and viewpoints of what is observed must be given. In addition, this mixed-methods research is utilised so as to gain a more comprehensive insight into a research problem than can be provided by either the qualitative or quantitative approaches alone (Mahato et al., 2018). The study by Venkatesh et al. (2014) extended the guidelines of Venkatesh, Brown, and Bala (2013) for mixed-methods research, by identifying and integrating variations in mixed-methods research. By considering 14 properties of mixed-methods research, their guidelines demonstrate how researchers can flexibly identify the existing variations in mixed-methods research, proceeding accordingly with a study design that suits their needs. This study reveals that both qualitative and quantitative approaches provide an opportunity to develop new theoretical perspectives by combining the strengths of qualitative and quantitative methods. The strengths of qualitative and quantitative methods occur when the researcher uses a mixture or combination of quantitative and qualitative method approaches in a single research study, to address a research question (Antwi & Hamza, 2015).

Moreover, a study by Maxwell (2016), conducted by means of reviewing earlier research in both natural and social sciences, integrated qualitative and quantitative approaches, methods. The study discusses some contemporary research traditions that use such integration without labelling it mixed methods. The findings of the study offer that a better understanding of the history and breadth of combining qualitative and quantitative approaches, methods, and data can be of significant practical value to mixed-methods researchers in designing their studies and drawing conclusions from their data. Researchers might then see the importance of both values of the quantitative and qualitative views of human behaviour (Antwi & Hamza, 2015). In conclusion, these researchers view the use of only quantitative research or qualitative research as limiting and incomplete for many research problems. Mixed-methods research is in favour of integrating both quantitative and qualitative approaches without criticising either one of the approaches, producing effective findings. Both quantitative and qualitative methods should be analysed and interpreted together, before arriving at a study's main conclusions (Yin, 2011). This points to the underlying belief in complementarity; that is, quantitative and quantitative approaches can be combined in

order to balance the advantages and disadvantages present within quantitative and qualitative approaches alone (Shannon-Baker, 2016).

4.2.4 Rationale for qualitative design

A qualitative design is deemed appropriate to this study because the aims and objectives of the study are directed towards providing an in-depth and interpreted understanding of the social world of research participants. The study also addresses the multiple meanings of individual understanding by learning about the sense lecturers make of their social situation (Jonker & Pennink, 2010). This refers to lecturers' private and public understanding of Turnitin utilisation. Tuli (2010) further argues that this method enlightens on human understanding and meaning within the given context. Understanding uses text, interpreting understandings and meaning to generate understanding, and recognising the role of the researcher in the constructing of knowledge. This statement is also supported by McMillan and Schumacher (2010), who affirm that the aim of this approach is to understand participants from their own point of view.

Using a qualitative approach, I was able to make knowledge statements based on the multiple meanings of individual understandings. I also attempted to draw conclusions from the data that reflected the interpretation of reality by participants (Wahyuni, 2012). These intepretations gave me an understanding of lecturers' Turnitin utilisation in assessing mathematics. Tuli (2010), confirms that a qualitative approach attempts to extend understanding of why things are the way they are in reality, and why people act the way they do. These actions were generated through open-ended questions; so that the participants were expressing their views. In other words, a qualitative approach was an apposite method for examining lecturers' understanding of Turntin utilisation. A study conducted by Thanh and Thanh (2015) examined the interconnection between an interpretivist paradigm and qualitative methods, supported by some relevant points of the authors's PhD thesis in education. The study took account of a number of scholars in showing that interpretivism is a trend of a research approach, using qualitative methods in data collection. This study supports that statement. In educational research, qualitative methods are likely to be the best-suited methods if a researcher seeks understanding and experiences of a group of students, teachers, or lecturers.

4.2.5 Limitations of qualitative approach

However, qualitative research approach has its own limitations. According to Cohen et al. (2011), qualitative researchers, as human beings, may bring their own knowledge (private understanding) to the research situation, and expect participants to behave in a particular fashion. This expectation leads to bias and subjectivity in interpretation of the results, qualitative researchers being very close to their research settings and participants (Pandey & Patnaik, 2014). In addition, in qualitative research, discussions about credibilty procedures provide litle guidance as to why one procedure might be selected for use by researchers over other procedures (Creswell & Miller, 2000). These procedures are often cited as being too specific for a particular social setting to be generalised to a wider world. The procedures also lack any statistical analysis, as well as sample-size calculation (Pandey & Patnaik, 2014). In addition, this reseach method lacks the work of objectives and measures of actions and opinions (Rahi, 2017).

4.2.6 Overcoming limitations of the qualitative approach

In dealing with such limitations of the qualitative approach, I planned and implemented the qualitative reseach method by carefully considering factors like the phenomenon under exploration, sampling, size, limitations, credibilty, and dependability, appropriate choice of data analysis, as well as cost and duration of this study (Cockcroft, Goldschagg, & Seabi, 2019). I also ensured the credibility of a study by using the viewpoint of participants emerging from the research (Creswell & Miller, 2000). Gray (2013) adds that, to avoid bais and subjectivity, it is wise to use multiple methods to balance any potential weaknesses that might have been raised in conducting the study. In accordance with this view, Petty et al. (2012) state that, in qualitative research, quoting words from various participants presents different voices and reflects different perspectives, to ensure the credibility. I therefore used reflective activity, face-to-face semi-structured interviews and document analysis, to minimise bias and subjectivity. In addition, I involved expert researchers' interpretation of data to control bias, as suggested by Golafshani (2003). Furthermore, in maintaining accuracy in this qualitative approach and the acceptance of quality work, I underwent trustworthiness procedures of credibility, transferability, dependability, and confirmability (Pandey & Patnaik, 2014). Creswell and Miller (2000) suggested, in using these four factors of trustworthiness, that I had to think beyond specific procedures to acknowledge the lens I employed in this study, and the choice of paradigm assumptions. I used emerging settings sensitive to the people and places under study, and data analysis that was inductive in establishing

patterns as well as themes (McMillan & Schumacher, 2014). This study is not aiming to generalise but to take a natural setting (Bashir, Afzal, & Azeem, 2008). These natural settings and meanings generated are based on interpretation of the data, rather than on generalising (Bashir et al., 2008; Rahi, 2017). Moreover, the qualitative research method depended on the fitness for the purpose of this study (Tuli, 2010). In this study, I avoided intervening in the natural flow of the participants' behaviour, as this occurs in all of its detail, the behaviour occurring naturally and holistically (Antwi & Hamza, 2015).

4.3 Research Paradigm

The term 'paradigm' defines an essential collection of beliefs shared by scientists; a set of agreements about how problems are to be understood, how we view the world, and thus go about conducting research (Rahi, 2017). In the same vein, Wahyuni (2012), declares that a research paradigm is described as a set of basic assumptions and beliefs on how the world is observed, which then serves as a thinking framework that guides the behaviour of the researcher. A paradigm is shared beliefs, the identity of a research community, a way of pursuing knowledge, consensus on what problems are to be examined and how to examine them, usual solutions to problems and, an understanding that is more accepted (Cohen, Manion, & Morrison, 2007; Cohen et al., 2011a). According to the study conducted by Wahyuni (2012), research paradigms are fundamental beliefs that affect the ways of conducting social research, including the choice of a particular research methodology. However, epistemology is important in choosing methodology. Methodology refers to a model for partaking in a research process in the context of a particular paradigm (Thanh & Thanh, 2015). Methodology includes all parts of a broad field, such as data gathering, participants, instruments utilised, and data analysis (Kivunja & Kuyini, 2017). This study give details of the elements of case-study design, including the justification to choose case organisations. The sections discussed present an overview of the required data and collection methods and discussed the methods used to analyse the collected data. The study also presented considerations regarding research quality. According to the study, there are three types of research paradigm, namely, positivism, pragmatism, and interpretivism. These paradigms are discussed below consecutively.

4.3.1 Positivist paradigm

For positivists, the purpose of the research is scientific explanation (Tuli, 2010). The scientific approach is perceived as the leading method of understanding the universe and pursuing proofs to gain solutions (Song & Shen, 2019). The positivist identifies the research problem, reads literature concerning a problem, develops a hypothesis on the solution to the problem, and implements a method to test the hypothesis (Procter, 2019). Positivists believe that reality is objective, and is measurable, using properties which are independent of the researcher and instrument, meaning, knowledge is objective and calculable (Antwi & Hamza, 2015). Dauda (2019) declares that positivism can be seen as a research approach that is based on the principle that reality is independent of the observer. Corroborating this view, in the positivist paradigm, emphasis is placed on explaining behaviour through measurable data by using standardised tools, for example, questionnaires, psychological tests with accurately worded questions, and this is done sequentially (Procter, 2019; Tuli, 2010). Generally, a positivist paradigm claims that the study of humans could be conducted a similar way to the study of nature, with an acknowledged set of rules for conducting and reporting the results (Gray, 2013). This is based on professional understanding of human nature. This paradigm highlights that there is a single reality within known probability, objectivity, empiricism, and numbers (McMillan & Schumacher, 2010). In this paradigm, social reality is considered a complex result of causal relations between events, with the cause of human behaviour external to the individual (Petty et al., 2012).

Knowledge of this reality is through observation: whatever can be observed is believed to be real, whether in the natural or social world, but knowledge is a result of social conditioning (Petty et al., 2012; Wahyuni, 2012). Positivists take a role of outside perspective, separating themselves from interfereing with the research (Wahyuni, 2012). In this paradigm, researchers explain numerically how variables relate, moulding cases and causing results (Tuli, 2010). The author further states that, in most cases, these explanations are developed and tested in experimental studies (Tuli, 2010) by placing rational observation as the key to understanding the social world, as well as to discover it (Corry, Porter, & McKenna, 2019). Hence, their beliefs are based on a universal generalisation that can be applied across contexts (Wahyuni, 2012).

Based on the above studies, positivism supports a closed-system ontology which posits a system of rigid regularities that are closed to transformation (Song & Shen, 2019). To put it differently, understanding social reality needs to be framed in a certain context of relevant laws or dynamic social structures which have created the observable phenomenona within the social world (Wahyuni, 2012). Premised on this, positivist science has drawn up a set of norms, for conditioning and limiting human behaviour in agreement with naturalistic ideas (Loconsole, 2019). In short, positivism is a sort of objective investigation, in the sense that it reflects an intersubjective reality (Dauda, 2019)). Positivism supports offering an independent opportunity to the analyst to collect proper data as needed by the research, which seeks objective reality, per numbers and statistical trends (Kumar & Murali, 2019; Noriey, 2019). This approach involves reductionism, that is, the problem is reduced to its smallest elements. It is believed that reduction enhances a problem's understanding (Holden & Lynch, 1998) in order to ensure that the study measures or tests what it intends to test (Pandey & Patnaik, 2014). Consequently, the study maintains a stable and unchanging reality, which is based on a belief that people's perceptions and statements are either true or false, wrong or right, and based on a view of a hard knowledge, real and acquirable (Antwi & Hamza, 2015). A positivist paradigm believes that the findings that are collected from a larger population is objective and driven by numbers to gain statistical data. However, the positivist paradigm was challenged by the pragmatist paradigm. According to Rahi (2017), this paradigm was challenged by postpositivists regarding the belief of this absolute truth, especially in relation to studying human behaviour in social science. This drawback gives rise to a pragmatic paradigm which is characterised by a concern for individuals (private understanding) (Ponelis, 2015).

4.3.2 Pragmatist paradigm

Pragmatism is another branch of a research paradigm. Pragmatism focuses on connecting abstract issues on the epistemological level to the methodology level. The aim of the pragmatic paradigm is to find the weakness in the study, and to strengthen it by using a mixed-methods approach (Rahi, 2017). Cohen et al. (2011) share that this paradigm consists of single and multiple versions of the truth and reality, sometimes subjective and sometimes objective, sometimes scientific, and sometimes humanistic. The exact mixture of this paradigm is considered appropriate, and depends on the research questions as well as the situational and practical issues facing a researcher (Antwi & Hamza, 2015). Pragmatists emphasise that one should view research philosophy as a continuum,

rather than to take an an opposite direction (Wahyuni, 2012). Pragmatists emphasise communication and shared meaning-making to create practical solutions to problems (Shannon-Baker, 2016). According to Cobb (2011), the solutions to these problems are based on scientific practice, as well as on everyday life, grounded on the beliefs of the pragmatic paradigm. In this paradigm, the researcher is free to use both quantitative and qualitative approaches. The essential purpose is to find the the best techniques and procedures of the research to solve the problem (Rahi, 2017), the emphasis being on what works best to address the research problem at hand (Wahyuni, 2012). The pragmatic paradigm has proven to be a great tool to go beyond testing a particular idea, while describing the status quo (Feilzer, 2010). In this paradigm, a reseacher is capable of maintaining both subjectivity in own reflections on the research, and objectivity in data collection and analysis (Shannon-Baker, 2016). Here data collected is analysed with the purpose of understanding complex issues in society, and to support the findings based on the pragmatic paradigm (Mahato et al., 2018), since this paradigm is not bound by any system, not bring affiliated to any structure (Rahi, 2017). This freedom provides pragmastists an option that tries to take both advantages of the similarities and differences in qualitative and quantitative approach methods, showing them how research can proceed without solving the potential conflicts in worldviews (Yin, 2011). This gives the pragmatists a more comprehensive insight into the problem than can be provided by the qualitative or quantitative approach alone (Mahato et al., 2018). Based on the above literature, pragmatist researchers prefer to work with both quantitative and qualitative data, because this enables them to better understand social reality (Wahyuni, 2012). However, to bridge these contradictions, it is as well to understand the rationale of the interpretive paradigm.

4.3.3 Interpretivist paradigm

The interpretive paradigm is categorised according to personalities (Cohen et al., 2011a), as maintained by a study conducted by (Petty et al., 2012), which focused on the use of qualitative research to assist their practice. The study argues that a greater use of qualitative research will help develop a more robust and comprehensive knowledge used in practice, and generated from the two research paradigms explored. In the study, it is revealed that the interpretive paradigm entails philosophical assumptions which involve ontology, epistemology, and methodology/axiology. Ontology specifies the form and nature of reality and what can be known about reality (Tuli, 2010). The ontological supposition of the interpretive paradigm is that reality is made and proven through

experience gained from interacting with individuals, as it does not exist already (Snape & Spencer, 2003). This approach attempts to expand understanding of why things are the way they are in reality, and why they act the way they do (Tuli, 2010). It also seeks to determine the real nature which constitutes themes that we analyse to make sense of the meaning implanted in research data ((Kivunja & Kuyini, 2017). In this paradigm, researchers use systematic procedures, but maintain that there are multiple socially constructed realities. Because of this assumption, the social world cannot be researched in the same way as the natural world. Researchers consider professional judgment as well as perspectives in the interpretation of data (McMillan & Schumacher, 2010; Petty et al., 2012). These social realities are regarded as the product of processes by which social actors together negotiate the meanings for actions and situations (Petty et al., 2012).

Epistemological assumption is concerned with the nature of knowledge, and how it can be acquired (Snape & Spencer, 2003). Corroborating this view, Kivunja and Kuyini (2017) argue that epistemological assumption is used to describe how we know something; how we know the truth or reality, and how it can be communicated to other human beings. Knowledge of this reality consists of understanding the multiple views of people in a particular situation (Petty et al., 2012). In the case of this study, the knowledge consists of the view of lecturers' understanding of utilisation of Turnitin in assessing mathematics in their teaching practice. Moreover, in the interpretive approach, researchers study the social reality from the perspective of the participants themselves (Wahyuni, 2012). Generally, in this case, epistemology deals with the connection between the researcher and that being researched (Tuli, 2010). In interpretivist belief, true knowledge can only be obtained by deep interpretation of participants (Rahi, 2017), indicating public understanding. Interpretive epistemology is among the subjectivism paradigm that is conducted in a real world (Thanh & Thanh, 2015).

4.3.3.1 Rationale for using interpretivist paradigm

The choice of interpretive paradigm in this study is based on the framework that guided me to understand the phenomenon. Ritchie et al. (2013) assert that the purpose and objectives of the interpretive paradigm are directed at providing an in-depth and interpreted understanding of the social world of the research participants, by learning about the sense they make of their social circumstances, their empathies and perspectives. Tuli (2010) argues that interpretive studies seek

to explore peoples' experiences and their understandings of these experiences. Therefore, the interpretive paradigm is deemed suitable for this study. I was therefore guided by the interpretive paradigm to discover the different understanding of lecturers, and their experiences from their point of view (Ritchie et al., 2013). Rahi (2017) states that followers of the interpretive paradigm believe in a deep understanding of a concept, and explore the understanding of the world in which they live. As a result, I used interpretive paradigm to gain insight and in-depth information (Cordella & Shaikh, 2006). The implication is to understand the world (public understanding) as it is from a subjective point of view (private understanding) and seek an explanation within the frame of quotations (professional understanding) of the participants (Wahyuni, 2012). In this case, I used an interpretive paradigm to explore lecturers' understanding, considering professional judgment and perspectives in the interpretion of data (McMillan & Schumacher, 2014).

Therefore, in one way or the other, a researcher has to explore and understand the social world through the participants and their own perspectives (Snape & Spencer, 2003). This meaning should be based on the concept of epistemology, the process in which the investigator comes to know the truth and reality (Antwi & Hamza, 2015). The researcher's intent, then, is to make sense of the meanings others have about the world (Kivunja & Kuyini, 2017). This indicates that researchers within the interpretivist epistemology are naturalistic, since they apply the basic knowledge that is generated from real-world situations as it unfolds naturally. They tend to be non-manipulative, unobtrusive, and non-controlling (Antwi & Hamza, 2015). Futhermore, according to Thanh and Thanh (2015) the selection of research methodology depends on the paradigm that guides the research activity, more specifically how knowledge can be gained. Therefore, through the lens of the interpretive paradigm, I examined the methodological aspects of this study to determine the research methods to used and how the data was analysed data (Thanh & Thanh, 2015), the study being guided by the aforementioned style. In addition, the paradigm was employed because of its approachable means of examining reality (ontology) (Snape & Spencer, 2003). In addition to the aspects of epistemological position of interpretivist relating to the systematic methods, my acceptance of the interpretivism is reflected in practices which emphasised the importance of understanding lecturers' viewpoints in the context of the conditions and circumstances of their lives (Cohen et al., 2011a). Therefore, in order to understand lecturers' viewpoints, in this study I followed the suggestions of (Yilmaz, 2013). As suggested, I became the research instrument, and

engaged different techniques and methods (Yilmaz, 2013). Owing to this, I used reflective activity, one-on-one semi-structured interviews, and document analysis for data gathering (Tuli, 2010). Furthermore, I established close contact with the participants when gathering the data, which is detailed, rich, multifaceted, and widespread (Yilmaz, 2013). Within the interpretive paradigm, I was naturalistic, since I applied it to real-world situations as they unfold naturally. More specifically, I was also non-manipulative, unobtrusive, and non-controlling (Tuli, 2010).

The interpretive paradigm has been criticised for being not solid, changing over time and place, as well as not being interested in generalising beyond the participants being studied (McMillan & Schumacher, 2014). This paradigm is perceived to be lacking generalisation which leads to the accusation that it is soft and unscientific (Petty et al., 2012). Irrespective of the criticisms based on the interpretive paradigm, this study benefited by this paradigm. Its purpose was to depend on the participants' understandings of the situation being studied, as well as recognising the impact on the study on the participants' background and experiences (Cohen et al., 2011a; McMillan & Schumacher, 2010; Yin, 2003). In addition, using an interpretive paradigm contributed to generating deeper insight into the context under study, adding richness and seeking depth to the data, rather than generalisation (Yin, 2012). This richness of data generated leads to the transferability of a study to another similar setting (Petty et al., 2012).

Furthermore, through the use of this paradigm, I was able to uncover the reality through interacting with the participants' minds. Snape and Spencer (2003) state that reality is only knowable through the human mind and socially constructed meanings. Using an interpretive paradigm, I was realistic, since it was applied to real-world situations as they unfold naturally (Tuli, 2010). In this study, knowledge of this reality involves understanding the multiple views of lecturers' understanding of Turnitin utilisation (Creswell, 2013). In interpretive ontology, participants are able to make meanings of their own realities, coming to appreciate their own construction of knowledge through practice (Scotland, 2012). Therefore, the interpretation made in the study was the understanding gained through the interplay of the participants.

4.3.3.2 Disadvantages of interpretivist paradigm

As with other paradigms, the interpretive paradigm has disadvantages in the study. The interpretive paradigm is perceived as inactive, contextual, subjective, and a relative view (du Plooy-Cilliers, 2014a). This paradigm is criticised for not being solid, changing over time and place. It does not generalise beyond the participants being studied (McMillan & Schumacher, 2010). This is a limitation within the interpretive research with regard to generalisability, making such recommendations unsafe (Ponelis, 2015). These recommendations lack a method that provides objective or precise information (Thanh & Thanh, 2015). In addition, the supporters of the interpretive paradigm do not accept the belief of universal standards for research (Thanh & Thanh, 2015). Lichterman (2017), explains how interpretive reflexivity widens ethnographers' ability to assess casual as well as interpretive claims. Such occurs through conversational essays discussing how ethnographers perform reflexivity, and how their research may reflect interests or biases that accompany their position in hierarchies of domination. This essay further discusses that positional reflexivity uneasily straddles a realism that claims to know which position(s) has/have affected the research; and a normativism that aims to demystify what they claim to know. The discussion continues that both stances overpower the interpretive work that researchers and researched are constantly doing.

Furthermore, in a more interpretive practice of reflexivity, ethnographers explore how they unearth other people's meanings in the field, instead of focusing on correlations between their claims and their social position. This study reveals that interpretive positionality yields partiality not universality, and that interpretive tracks miss connections, losing the opportunity to act differently by attaching meanings differently (Lichterman, 2017). These different meanings, at times, might exclude the relevant information; or at times might reveal hurtful information at the cost of less transparent interpretation (Nordqvist, Hall, & Melin, 2009). The lack of transparent interpretation is perhaps owing to space restriction in published manuscripts, leaving other researchers unsure of the mechanism for using this methodology (Callary, Rathwell, & Young, 2015). The reason might be the subjective nature of interpretive paradigm; and the great room for being biased on the side of the researcher. Principal data gathered within interpretivist studies cannot be universal, since data is compressed by individual perspective and principles (Noriey, 2019). This is because the realities and standards are not different; and the results are unavoidable, subject to the

investigators' opinions and principles, thus making it difficult to carry out an objective that is value free (Snape & Spencer, 2003).

A research conducted by Malik (2020) attempted a comprehensive, structured overview of the specific conceptual, procedural, and statistical limitations of models in machine learning when applied to social community. The study concentrated its attention on four failure points of a quantitative-only approach. First, it narrates to the unfeasibility of quantifying meaning-making. Second, it relates to the difficulty of measurement in social science. Third, it narrates to experiences and personal knowledge. Last, it narrates to how quantification can succeed by imposing its logic on the world, totally separate from any notion of correspondence or having empirical adequacy. This study points out that some limitations of interpretive paradigm are naturally biased and dependent (Malik, 2020). Furthermore, according to Cohen et al. (2011a), the interpretive paradigm rejects scientific procedures of ratification and losing hope of unearthing helpful generalisation concerning conduct.

However, in overcoming the disadvantages of the interpretive paradigm, Uztosun (2013) argues that a study depends on the participants' views, as social actors. The results of this research cannot be generalised to other contexts. In the interpretive paradigm, participants' responses are part of their personal understanding and educational context, and significant. My interpretation is embedded in the participants' understanding of the social world (Horton et al., 2019). The idea behind the interpretive paradigm is to understand the participants' interpretations and their experiences of the world around them (Cohen et al., 2007). In support of this view, Khairin and Ulfah (2018) declare that the reason behind using the interpretive paradigm is to find the hidden meaning from the participants' points of view on how they interact with the world as they understand it.

4.4 Research Style

A research style is a logical sequence that connects the empirical data to a study's initial research questions and to its conclusion (Gunn et al., 2017). It is remarked that, if the research style matches well with the research questions, it gathers the best data for answering questions (Leppäaho, Plakoyiannaki, & Dimitratos, 2016). Research questions for this study were explored using the

case-study approach, to gather the best data. According to Yin (2014) thus, in this study I explored lecturers' understanding of Turnitin utilisation in their natural setting to a gain answers to the research questions. A case study examines a case over time, in depth, employing multiple sources of data found in the settings (McMillan & Schumacher, 2014). It also provides a unique example of people in real situations, enabling readers to understand ideas more clearly (Cohen et al., 2011a). Leppäaho et al. (2016) identified and analysed 75 articles in the family business (FB) literature between 2000 and 2014, focusing on the case design they adopted. These authors found the positivistic case-study approach to be the FB disciplinary convention, while critical realism and interpretivism approaches were used to a significantly lesser extent. This study reveals that there are three types of case study, namely, explanatory case study, descriptive case study, and exploratory case study (Leppäaho et al., 2016). The next section briefly discusses the types of case study, consecutively.

4.4.1 An explanatory case study

Explanatory case study investigates the varying degrees of relationships between existing variables (Davis, 2014). An explanatory case study indicates positivism, being based on testing the theories (Gray, 2013; Rahi, 2017), indicating professional understanding. A study conducted by Jones and Rakovshik (2019) investigated situation–specific responsibility and explanatory style in social anxiety disorder (SAD), according to the cognitive model. This investigation targeted participants from the age of 17 to 68 years old, including waiting-list patients referred to a primary-care mental-health service offering cognitive behaviour therapy for SAD. This study adds to the definition made by Gray (2013) as well as Rahi (2017), that explanatory case study tests how people tend to attribute causations for outcomes to situations along a set of dimensions linked to their own and other's agency. Another study conducted by Fernandes (2018), on Knights of Columbus (KofC) volunteers in Ontario, Canada, tried to understand why they demonstrate motivation, organisational commitment, and engagement. The scope of this study was guided by two main questions, which are "Why do KofC members volunteer?" and "How do KofC members combine elements of motivation, organizational commitment, and engagement in their volunteer activity?" This study declares that the benefit of using explanatory case study design is allowing unanticipated theoretical concepts influencing the participant activity to emerge from further review data. The study further reveals that the explanatory case-study design uncovers deep truths

about the case. These cases involve explanations based on formalising theoretical scenarios, explanations based on pragmatically establishing cause and effects, as well as explanations based on writing thick descriptions (Cornelissen, 2017). In addition, an explanatory case study is carried out to investigate aspects of the historical event of individuals or organisations (Griffin, 2017). In these events the most appropriate questions focus on how and why, in order to collect rich in-depth data (Little, 2017). Furthermore, the researcher is able to gain an in-depth understanding of the phenomenon of interest (Lane, Tiwari, & Alam, 2016). Based on the above studies, an explanatory case study comprises investigating historical events of individuals, people, and organisations. These investigations aim to explain how and why such events happen (Yin, 2003). Explanatory case-study design is not appropriate for this study, because explanatory case study investigates historical events of individuals, people, or organisations.

4.4.2 Descriptive case study

A descriptive case study describes the characteristics of the phenomenon, and relations between variables, or relationships between phenomena, as accurately as possible (Davis, 2014). In addition, a descriptive case study is defined as a design that retains a role in sharing of innovations and initial ideas. This study focuses on the first step in the scientific method by addressing the questions (Lim et al., 2017). However, Yin (2017) argues that descriptive case study is called description plus a call for action. A qualitative descriptive study was conducted by Avery (2019) exploring college students' perception of the influences mobile technology has had on their education. The data collected included information obtained from 13 graduate students, with the use of a demographic questionnaire, personal interviews, and focus groups conducted via an online web-conference site. This study indicates that, with the use of a descriptive case study, a researcher is able to obtain information that describes the participants' perceptions and experience for educational purposes. Avery (2019) further argues that allowing the participants to describe their actual thoughts, feelings, and beliefs regarding the benefits or challenges in terms of the phenomenon, improves the credibility of the study. By gathering the thoughts, feelings, and beliefs of the participants related to the phenomenon, strategies and approaches for focusing on humanistic aspects can be gathered (Hartman, Townsend, & Jackson, 2019). This study was conducted with the purpose of supplying an in-depth description of educators' values, beliefs, and

confidence in changing from a traditional learning environment to a learning environment integrating technology.

In addition, descriptive case study is applied to review the development of current policies and of a regulatory framework for professionals, to improve its future implementation (Sonoda et al., 2017). Furthermore, the descriptive case-study design was employed using descriptive statistical analysis on data collected. Thus, this description case study indicates public understanding. In support of Yin (2012), a classroom action-research study was conducted by Syamsul (2015) on using concept maps at VIII D students, aiming to improve the students' writing ability in composing descriptive text through direct action. This study reveals that the use of the descriptive case study was able to improve the students' writing in composing descriptive text through direct action. As Carter (2018) argues, a descriptive case study in education presents a detailed account of a situation under study. Based on the above studies, the descriptive case study is aligned with the action research. A descriptive case study indicates action research because it appears when a research strives to support some subsequent action, longing for transformation in the nation (Yin, 2012).

4.4.3 Exploratory case study

Exploratory case study examines a topic which has been previously researched; and is designed to lead to further inquiry analysis and review inquest (McMillan & Schumacher, 2014), indicating private understanding. This tallies aptly with the intention of this study which was to examine lecturers' understanding. This led to further analysis of the research, with the intention of attaining an insider's view on the lecturers' understanding of Turnitin utilisation in assessing mathematics. A study was conducted by Antwi and Hamza (2015) discussing quantitative and qualitative research methodologies within the broad field of business research. Looking for similarities and differences between quantitative and qualitative methods, the study gives an overview of the historical development of both approaches, the paradigms, and interpretative frameworks. It discusses major advantages and limitations, examining the trend to combine both quantitative and qualitative data in a single research project, in an effort to reconcile both approaches. This study indicates that the goal of using exploratory case study is to attain insider's view of the group under the study.

Furthermore, using an exploratory case study offers the possibility of scoping an analytic approach for further development. The purpose of using exploratory case study was to elaborate a concept, improving a model with its suggested proposition (McMillan & Schumacher, 2010). Moreover, the exploration indicates a means of gaining in-depth understanding of local, emic meanings, and of remaining open to alternative viewpoints and tensions in the setting of the participants (Hall & Nordqvist, 2008). This assertion resonates with the purpose of this study, in which the ultimate objective was to understand the in-depth situation, flexible from the participants' perspective, also allowing for tension from the participants' natural setting. Premised on this, the exploratory case study is aligned with the interpretivist case study, which supports the idea that knowledge development concerning the social world depends on human interpretations. Within the social world, the questions set in the study were explored, described, evaluated, theorised, discussed, and interpreted with regard to complex issues in the context (Harrison, Birks, Franklin, & Mills, 2017). These interpretations were generated from the research questions of what, how, and why, in a non-controlled context, to analyse current real circumstances with all their complications (Chaboyer, McMurray, & Wallis, 2010). In other words, lecturers were assisted to make meaning of the knowledge in practical settings, which might give them the opportunity of linking theory and practice (Popil, 2011).

This view is supported by Hodkinson and Hodkinson (2001), who drew on past and current research investigations to examine the strengths of case-study research. Hodkinson and Hodkinson (2001) argue that, despite difficulties engaged in doing a case study, it facilitates the construction of detailed in-depth understanding of what is studied. In this case study, I was able to reflect with the participants, and revise meanings and understandings of utilising Turnitin (Nordqvist et al., 2009). On this premise, the interpretations assisted to bring subjectivity to the fore, supported by rich contextual data and thick descriptions. Thick descriptions are the product of the relationships within face-to-face interactions among participants in a social setting (Yilmaz, 2013). An effective interaction between the participants and researcher was created by a carefully planned case study. This planning provided a strong supportive means of examining conditions where there were doubts concerning the lecturers' understanding of Turnitin utilisation, more especially because I had little control over the case (Antwi & Hamza, 2015; Gray, 2013). In addition, this is a kind of plan that leads to the process of gathering, analysis, and interpretation of the available data (Aczel,

2016). According to Dresch, Lacerda, Augusto, and Miguel (2015), in the process of data gathering, multiple sources of evidence, such as interviews, document analysis, and a questionnaire should be used. This process also allows for the flexibility to understand the unknown areas of the research (Davis, 2014). This is the reason Cohen et al. (2011a) perceive a case study as an inquiry into a specific phenomenon in its real-life situation. Hence the adoption of a case study in this research, in order to give a written description of the situation, offering insights into the nature of the lecturers' understanding (Rahi, 2017). In this respect, I was able to gain a holistic and real-world viewpoint through the participants (Yin, 2014).

4.4.4 Disadvantages of a case study

As with any other research design, a case study has its limitations. Aczel (2016) states that many authors see the case study as irregular of social research design. In the same vein, Popil (2011) argues that there are some limitations and obstacles which might be encountered in a case study. Developing a case may be difficult and time-consuming (Popil, 2011). In this research approach, the strategy is a written description of a problem or a situation. It presents small group problems or focuses on a particular issue (Rahi, 2017). In conducting case studies, there is a risk of lacking objectivity, quantification, representative significance, and strength (Aczel, 2016). In addition, a case study is perceived as too subjective (Gog, 2016). A study conducted by Massaro, Dumay, and Bagnoli (2019) aimed to analyse how, why, and where authors use citations of Robert Yin's classic text, Case Study Research: Design and Methods, to determine the application of methodology transparency in published case-study research. This analysis study was conducted using a structured literature methodology. The findings of the study reveal that there is a lack of transparency in a case study, which could harm the trust readers place in case-study findings. Case studies do not demonstrate reliability and validity, which may be, by definition, inconsistent with other case studies (Cohen et al., 2011a). This is one of the reasons some investigators do not grant the case study any merit as a research method (Yazan, 2015). Furthermore, Leppäaho et al. (2016) add that space limitations in a case study make it difficult for authors to discuss in detail methodological choices, and analytical procedures. Despite all the limitations mentioned on a case study, case studies investigate a contemporary phenomenon within its real-life context, especially when the limitations between phenomenon and context are not clearly evident (Yin, 2003).

4.4.5 Overcoming limitations of a case study

There are possibilities to overcome the disadvantages of case study. Yin (2014) posits that, in order to overcome these limitations of conducting a case study, there are skills required from the researcher, namely, questioning and listening skills (Popil, 2011). Exercising these skills empowered me to treat all the participants equally, without interference in the research; and allowed me to keep my personal issues to myself. Normally, in case studies, some flexibility in word limits may be needed, to allow accuracy in the reporting of the research. (Leppäaho et al., 2016). Similarly, using the case study allowed me the flexibility of making changes even after I had proceeded with the case. Yazan (2015) declares that the advantage of using the case study is its flexibility of allowing researchers to make changes even after they proceed from design to research case. I used the case study to elucidate lecturers' understanding of utilisation of Turnitin in assessing mathematics in a single university (McMillan & Schumacher, 2014). This indicates that the case study is an important means of gaining deep understanding of the difficult contemporary phenomenon (Tumele, 2016). In addition, I preferred to use the case study because, as a researcher, I had little control over events (Rahi, 2017). This allowed me to keep the fieldwork notes; and the experience of living there became an important addition to data-gathering techniques that I used (Myers, 1997). It also gave me enough time to gain relevance and gain more in-depth explanations and descriptions (Gog, 2016). These descriptions generated from the case study were authenticated by peers, informants, and participants, to overcome the limitations (Massaro et al., 2019). I allowed the data in the case study to speak for itself, rather than judging it (Cohen et al., 2011b). I used direct quotations to display transparency, rather than paraphrasing (Massaro et al., 2019). As a result, I did manage to undertake the research without interfering with the data generated.

4.5 Data Source

To gather primary and secondary data required to answer questions set for the study, the following sources were chosen for gathering information:

Two documents

- Plagiarism policy
- Turnitin training manual and
- University of KwaZulu-Natal lecturers teaching Mathematics

4.6 Sample and Sampling

Sampling is using a number of people or things which are the subject of the research (Etikan, Musa, & Alkassim, 2016). In this respect, a sample is a selection from a larger group of individuals, recognised as the population (McMillan & Schumacher, 2014). There are two methods of sampling, namely, probability, and non-probability sampling (Cohen et al., 2011a; Etikan et al., 2016; McMillan & Schumacher, 2014). According to McMillan and Schumacher (2014), in probability sampling, participants are drawn from a larger population, so that the probability of selecting each participant of the population is known. In non-probability sampling, subjective methods are used to decide which participants are to be involved in the sample (Etikan et al., 2016). According to Cohen et al. (2011a) probability sampling draws randomly from a wider population. It seeks to represent a wider population and it is also useful for generalisations. On the other hand, non-probability sampling is used to gain insight into a variety of issues (Cohen et al., 2011a; Skowronek & Duerr, 2009). There are four major types of non-probability sampling, namely, quota, snowball, purposive, and convenience sampling, (Budden, 2017; Luciani, Campbell, Tschirhart, Ausili, & Jack, 2019; Moser & Korstjens, 2018; Sarstedt, Bengart, Shaltoni, & Lehmann, 2017).

In quota sampling, the researcher pre-stipulates the control characteristics, controlling their distribution in the target population (Sarstedt et al., 2017). Based on the proportion of the sub-groups necessary for the final sample, interviewers are given the number of units from each sub-group to choose for the interview, as posited by Budden (2017). In addition, quota sampling strives to represent substantial characteristics of the broader population (Cohen et al., 2011a). This sampling does not tally with the purpose of this study. On the other hand, Tuherdoost (2016), asserts that snowball sampling is a non-random sampling method that uses a few cases to help encourage other cases to take part in the study, thereby increasing sample size. This sample allows the existing participants to recruit future participants from among their connections (Verel, Daolio, Ochoa, & Tomassini, 2018). Moreover, Rahi (2017) adds that, in using the snowball sampling technique, the researcher makes initial contact with a small group of people who are relevant to the research topic, using them as referrals to recruit other people. This approach is most appropriate in small populations that are difficult to access, owing to their closed nature (Tuherdoost, 2016).

The purpose of this study was to target the appropriate small populations that are easily accessible, and who are also knowledgeable on the topic. Convenience and purposive sampling are less expensive, less time-consuming and perfect for exploratory research style (Tuherdoost, 2016). This sampling is based on the researcher's judgment, and the ease with which potential participants can be found is the primary consideration (Sarstedt et al., 2017). According to Budden (2017), uniting convenience and purposive sampling has enabled the study to select the participants who can provide in-depth accounts of their experience. The previous statement indicates that convenience and purposive sampling are suitable for this study. Hence, the selection of both sampling strategies is appropriate for this study.

4.6.1 Convenience sampling

Convenience sampling is also known as opportunity sampling (Budden, 2017). It is a process that chooses the closest individuals as participants, continuing this process until the required sample size has been confirmed. This sampling strategy is used in case studies (Cohen et al., 2011). According to Luciani et al. (2019), this type of sampling involves the recruitment of the participant directly in the field, and according to the opportunity available at that particular time. At the same time, convenience sampling is reasonable in term of costs, and the participants are easily accessible (Etikan et al., 2016). According to Jager, Putnick, and Bornstein (2017), this sampling is efficient, and simple to implement. Sural (2018) further posits that, in this sampling type, the first available data is used for the research, without additional requirements. In convenience sampling, there is no need for a list of all the population elements (Acharya, Prakash, Saxena, & Nigam, 2013). According to Budden (2017), the assumption related to convenience sampling, is that this sampling is the simplest method of obtaining the participants who have knowledge of the phenomenon, who might feel free to share, to reflect their experiences concerning the research conducted. The selection of lecturers who were to partake in this study was done to eliminate ethical disputes of compelling participants to participate in a study (Budden, 2017). As in the case of this study, the proposed participants numbered seven. Ultimately, I collecting data from four lecturers who are teaching mathematics at a particular university because I could not oblige all suitable participants to participate in the study. The other three lecturers who turned down the request to take part in the study, were not familiar to me. This is in accordance with Tuherdoost (2016), who states that, in convenience sampling, it is better to use friends or family than to target unknown people. These

participants were selected because they were at the right place at the right time (Acharya et al., 2013). In other words, the four chosen participants were easily found, and were convenient to the study for both the researcher and the participants. These participants were easily selected through convenience sampling. The participants were conscious of the phenomenon, offering their understandings based on this approach (Sural, 2018). Hence, this approach was used in order to gather the information from those lecturers who were accessed readily and conveniently (Danish & Usman, 2010). Moreover, the participants were selected with the purpose of creating an environment in which they were free to share their understandings, in order to gain rich and meaningful data.

However, convenience sampling has its own disadvantages, the foremost being inconsistency and bias which cannot be measured or controlled (Acharya et al., 2013). The non-probability techniques are based on purposes that lead to assumptions, resulting in risk (Etikan & Bala, 2017). Furthermore, assumptions will generate inappropriate generalisation of the population (Etikan & Bala, 2017). This sampling is conducted without sufficient consideration of the conceptual definition of the population and with no careful consideration of potential biases (Meyer & Wilson, 2009). For most non-probability sampling procedures, "convenience" is contradictory. For the above-mentioned reasons convenience sampling is criticised (Landers & Behrend, 2015).

Nevertheless, convenience sampling assisted me to overcome many restrictions associated with the research (Tuherdoost, 2016). The adoption of convenience sampling requires very careful thought apropos of design and execution of the sampling plan (Meyer & Wilson, 2009). In addition, convenience sampling does not seek to generalise beyond the wider population (Kvam, 2019), but cautiously interprets the results of the study (Acharya et al., 2013). The knowledge gained should be generalised to the population from which the sample was drawn (Budden, 2017). Therefore, convenience sampling was chosen to suit the purposes of the study, which leads to purposive sampling.

4.6.2 Purposive sampling

Purposive sampling is a deliberate manner of choosing samples (Yin, 2012). This type of sampling is used to acquire an in-depth information from the participants who are in a position to provide it

(Cohen et al., 2011a). According to Luciani et al. (2019), all sampling decisions should be purposeful and chosen, because they best answer the clearly articulated research question. Skowronek and Duerr (2009) add that purposive sampling is used to limit expenditure to cost of paper needed to print questions, as well to limit cost of conducting a case study. Generally, in purposive sampling, the researcher uses own judgment to select a group of people who knows about the problem (Rahi, 2017), indicating private and public understanding.

In this regard, I purposely selected the lecturers who are teaching mathematics, with the intention of gaining the best information to address the purposes of the study (McMillan & Schumacher, 2014). The selected participants possess the relevant knowledge and experience; they are also available and willing to participate, and can communicate experience and opinions in an articulate, expressive, and reflective manner (Etikan et al., 2016). The idea behind purposive sampling was to concentrate on the lecturers with understanding of mathematics characteristics, who better assisted with the relevance of study (Etikan et al., 2016). In the sampling strategy selected, I was able to learn significant issues of central importance to the purpose of the study (Budden, 2017). Relevant participants have the desired knowledge, as revealed by their experiences (Budden, 2017).

Nevertheless, in purposive sampling, the researcher is the only one responsible for judging who is included in the study. The researcher might ignore others who possess the relevant knowledge of the phenomenon (Budden, 2017). However, techniques are used to locate the sample, and as such, the findings are not generalisable (Lamula, 2017). Etikan et al. (2016) postulate that purposive sampling is chosen because the researcher has something in mind, and participants that suit the study are included. In addition, the purpose of the study was not to generalise, but to generate information-rich cases for in-depth study, learning a great deal about issues of central importance (Patton, 2015). After several visits to the university, the research site from where the data processes were implemented, I targeted seven lecturers who are teaching mathematics, and had the opportunity to participate. Three lecturers turned down the request, owing to certain issues of confidentiality. Regardless of these responses, I was able to maintain participation from the four participants who voluntarily came forward to participate in the study. As a result, I focused on

those participants in generating the required data (Etikan & Bala, 2017). Table 4.1 below shows a summary of participants selected, and their various profiles.

Table 4.1: Summary of Participants' Profiles

Participant	Teaching Experience	Gender
Lecturer 1	10	Female
Lecturer 2	6	Female
Lecturer 3	10	Female
Lecturer 4	7	Female

Once the target population, sampling frame, technique, and sample size have been established, the next step is to generate data (Taherdoost, 2016).

4.7 Data Generation

There is no single prescription which data-gathering instruments use; this all depends on the fitness for purpose (Cohen et al., 2011a). The selected methods for data gathering should match research questions so that the best data for answering the questions is gathered and analysed (McMillan & Schumacher, 2010). In qualitative research, the major methods that are used for data generation are questionnaires, document analysis, interviews, observations, and audio-visual materials (McMillan & Schumacher, 2014; Moser & Korstjens, 2018). The data is generated from multiple sources to ensure that the data is rich, and confirms the findings (Boblin, Ireland, Kirkpatrick, & Robertson, 2013). This study employed three data-generation techniques, namely, reflectivity, interviews, and document analysis. These methods were used to answered the three questions of this study to ensure rich data, and to confirm the findings, as well as the questions guided by the TPACK concepts. The first question was: "What are lecturers understanding of Turnitin utilisation at a South African university?" The second question was: "How do lecturers understand utilisation of Turnitin at a South African university?" while the third question was: "Why do lecturers understand utilisation of Turnitin in particular ways at a South African university? The next section discusses how each of these three methods employed were used for data generation. First, I begin with reflectivity.

4.7.1 Reflective activity

This research was couched within reflective activity as the first approach to generate data from lecturers. Reflection is defined as an activity in which an experience is recalled (Martins et al., 2015). Ovens and Tinning (2009) add that reflection is an instrument which is used in different methods through the context, to unfold lecturers' own experiences, beliefs, knowledge, and philosophies which assist them to understand how these shape their identities and actions. According to Tsutsui and Takada (2018) a reflective activity is implemented so that a researcher is able to review content, and establish the gained knowledge. Marcosa, Miguela, and Tillema (2009) argue that, through reflections, the lecturer might better understand and extend his or her professional activity; and that reflection on teaching problems might lead to new insights into practice. Luttenberg et al. (2018) postulate that there are four categories of reflection, namely, scientific, technical, artistic, and moral. This study focuses on scientific, technical and moral reflections. Coldron and Smith (1999) further state that these reflections are about finding answers to questions such as: 'What is true?' (scientific reflection)', 'What is effective and efficient?' (technical reflection), and 'What is good?' (moral reflection). These questions relate to different content. For example, scientific reflection is about generalisable insights that are the result of scientific research activities (Luttenberg et al., 2018).

Scientific knowledge is motivated by frustrations of lecturers in their attempt to gain more effective control (Mortari, 2015), indicating professional understanding. In this form of understanding, which is known as reflection-on-action; the form of reflection after the task is completed in order to enlighten future behaviour (Gray & Coombs, 2018). Technical reflection is concerned with the efficiency and effectiveness of the means to achieve unproblematised ends (van Mannen, 1991 ; Zhu, 2011), Technical thinking can be about what lecturers actually do in practice (technical rationality), (van Mannen, 1991 ; Zhu, 2011), indicating private understanding. This understanding takes place in the context itself and works as a self-correction tool, tending to focus interactively on the action, its outcomes, and the intuitive knowledge implicit therein (Martins et al., 2015). Furthermore, artistic reflection is about the personal significance of the teacher in the real situation of his or her practice; for example, in everyday classroom interaction (Luttenberg et al., 2018). On the other hand, moral reflection is about general values that apply equally to everyone in every situation (Luttenberg et al., 2018), indicating public understanding.

This reflection is about extending awareness beyond the classroom to moral and social issues (Killen, 2007).

In accordance with the above statement, Lee, Edwards, and Team Lee et al. (2015) suggest that a reflective strategy might be useful for services in which lecturers might benefit from orienting themselves to long-term and deeper goals. The goal of reflections is to learn from experiences (Gray & Coombs, 2018). According to Kolb (2014), through reflective activity, an individual might learn from experience. The knowledge generated from reflective activity becomes a learning experience. Reflective writing and teaching experiences are expected to improve through a reflective process (Cohen-Sayag & Fischl, 2012). As part of developing understandings, beliefs, and attitudes, in education and teaching, it is suggested that reflective activity be examined regarding field experience (Cohen-Sayag & Fischl, 2012).

In this study a reflective activity was conducted once. This was handed to four participants for the duration of one month prior to the semi-structured interviews. This activity tool outlined the main themes of TPACK, which is the theoretical framework of the study. The participants were requested to answer the questions framed around TPACK, using the reflective tool as attached on Appendix1. The expected duration and measures were taken to ensure privacy and confidentiality (Marshall, Brereton, & Kitchenham, 2014). This activity was done to familiarise the participants with the questions that were used during the interview process. The reflective activity assisted me with understanding lecturers' utilisation of Turnitin. I collected the reflective activity two months before the interviews were conducted, since reflective writing is a demanding task for lecturers in time, effort, and personal exposure (Cohen-Sayag & Fischl, 2012). The reflective activity was received in two ways. Two participants sent their reflective activity via email; the other two handed me the responses directly. The participants went through a cognitive process in which they analysed their experiences taking into account prior knowledge, reformulating their own meaning that in turn led to new knowledge (Ozkan, 2019). As Amulya (2011) posits, positive experiences are powerful sources of learning for a reflective professional; for example, reflecting on breakthroughs assists to uncover practices and processes that lead to success.

Successful reflection instructs participants on a deeper level of their assumptions and definitions of success (Amulya, 2011). The written reflection stage permitted lecturers to reflect at a more abstract level (Allas, Leijen, & Toom, 2016). This level focused on integrating knowledge drawn from understanding of lecturers' utilisation of Turnitin to their existing knowledge systems (Allas et al., 2016). In this way, lecturers were able to express reflective thinking in the form of writing (Guce, 2017). Moreover, being reflective has been regarded as an essential asset for lecturers, since it empowers them to learn from their mistakes, while reflecting on their own practice, evaluating and changing such when necessary (Karatepe & Yılmaz, 2018). The whole process of reflection assisted lecturers to develop professionally (Karatepe & Yılmaz, 2018). In this respect, lecturers were offered the opportunity of reflecting on assessment practice and actions within their context. As a result, reflective writing was conducted in order to improve participants' reflectivity (Ozkan, 2019). Table 4.2 below indicates the questions on which the lecturers were to reflect.

Table 4.2: Reflective Activity Questions Framed on Concepts of TPACK

Curriculum concept	Question	Proposition	Reflection
Question1 Rationale	What do you understand about utilising Turnitin in assessing mathematics?	Content reason Personal reason Societal reason	Professional understanding Personal understanding Public understanding
Question 2 Goals	Towards which goals do you work when utilising Turnitin in mathematics ?	Objectives Aims Outcomes	Professional understanding Private understanding Public understanding
Question 3 Content	What content do you assess in mathematics, utilising Turnitin?	Geometry Algebra Trigonometry	Professional understanding Private understanding Public understanding
Question 4 Activities	What activities do you assess in mathematics utilising Turnitin?	Examinations Assignment Presentations	Professional understanding Private understanding Public understanding
Question 5 Assessment	How do you assess content and activities in mathematics utilising Turnitin?	Summative assessment Formative assessment Peer assessment	Professional understanding private understanding Public understanding
Question 6 Procedures	Which procedures do you use in assessing mathematics utilising Turnitin?	Product procedures Process procedures Critical procedures	Professional understanding Private understanding Public understanding
Question 7 Platform	Where do you assess mathematics utilising Turnitin?	Face to face platform Online platform Blending platform	Professional understanding Private understanding Public understanding
Question 8 Intervals	When do you assess mathematics utilising Turnitin?	Working period Spare time After working hours	Professional understanding Private understanding Public understanding
Question 9 Resources	What resources do you use when assessing mathematics utilising Turnitin?	Hardware Ideological-ware Software	Professional understanding Private understanding Public understanding

Because most of the lecturers are busy with preparation processes, it becomes very difficult to complete reflective activity within the time limit (Ozkan, 2019). In dealing with such limitations, the participants were given the duration of one month to undertake the reflective activity. At the same time, Mortari (2015) argues that, regardless of reflexivity deficit, reflective activity analyses in depth what cognitive acts reveal as a difficult reflective activity. In conclusion, the participants might not be honest enough to give the actual answer required on the reflective activity. The individual semi-structured interviews assisted in verifying whether the reflective activity portrayed the true reflection (Zuma, 2016). In addition to the methods used to elicit the participants' reflections, semi-structured interviews were also conducted.

4.7.2 Interviews

Interviews are a commonly used tool for data gathering (Moser & Korstjens, 2018). Other data-gathering methods include the interviewer asking the respondents questions face to face, by telephone, or online (Moser & Korstjens, 2018). There are different types of interviews, namely, structured, semi-structured, and unstructured (Cohen et al., 2011a; Young et al., 2018). In making this decision, researchers could weigh up the advantages and disadvantages of interviews as a methodology in the light of research questions (Young et al., 2018). Structured interviews are based on a fixed set of pre-determined questions, and this does not allow interviewees to shape the discussion (Punch, 2005; Young et al., 2018). Structured interview methods provide exact wording of questions that follow a precise sequence with specific rules for coding responses (Leffler, Riebel, & Hughes, 2014). On the other hand, an unstructured interview is useful when the researcher is unaware of what he or she does not know; hence, the researcher relies on the respondents to tell him or her, as remarked by Guba and Lincoln (1994). Besides, in unstructured interviews, the interviewer leads the conversation and follows what the interviewee says, since questions are not usually pre-planned (Wilson, Onwuegbuzie, & Manning, 2016). Furthermore, semi-structured interviews are suitable for gathering qualitative data, because they offer opportunity for discussions that arise during data gathering (Marshall et al., 2014). Examining three types of interview drove the study to the face-to-face semi-structured interview format.

4.7.2.1 Semi-structured interviews

Face-to-face semi-structured interviews have proved to be adaptable and flexible (Kallio, Pietila, Jonson, & Kangasniemi, 2016). The assumption of individual semi-structured interviews is that rich, in-depth knowledge may be obtained through creating an atmosphere of freedom and openness afforded by politeness (Budden, 2017). In individual semi-structured interviews, the questions should be broad and limited. This method is used to obtain more useful information from focused, yet conversational mutual communication with the participant (Pathak & Intratat, 2012). Careful and important phrasing of questions in the interview is important and draws on the pre-fieldwork research, as well as knowledge of the local characteristics (O'Keeffe, Buytaert, Miji, Brozovi´c, & Sinha, 2016). Furthermore, the questions should be clear and easily understood by participants, related to their own experiences, as well as ethically and culturally sensitive (O'Keeffe et al., 2016). In addition, Snape and Spencer (2003) indicate that one-on-one semi-structured interviews give researchers an opportunity of understanding deep-rooted experiences because of the depth of focus, as well as the opportunity for clarification and detailed understanding.

The questions were open-ended to accommodate a variety of responses. This was to gain as many details as possible. Follow-up questions were asked by using probes and prompts. These questions intended to encourage participants to tell their personal experiences, including feelings and emotions; and often, the focus was on lecturers' understanding of Turnitin utilisation (Moser & Korstjens, 2018). The average time of each interviews was one hour. The shortest interview took one hour and the longest interview lasted for one-hour and-forty-minutes. All one-on-one semi-structured interviews were recorded and transcribed using the audio recorder, with the permission of the participants.

Conversely, drawbacks of face-to-face semi-structured interviews drawbacks are reliance on the communication skills of the participant; therefore it is possible that the quality of the data generated may be limited owing to the participant's lack of experience (Marshall et al., 2014). In this respect, a researcher might be tempted to provide guidance to fit his or her own point of view (Moser & Korstjens, 2018), which would be unethical. According to Khansa (2015), participants might alter their responses, since they know why they are being interviewed. In dealing with drawbacks of

semi-structured interviews, to obtain the quality data, open-ended questions were employed to relieve participants of their fear of exposure, in order to help them feel relaxed when expressing their opinions (Makumane, 2018). The informal interviews were conducted before the commencement of the one-on-one interviews to avoid alteration of the information. To avoid temptation on the side of the researcher, quotations of participants exact words were used. In addition to reflective activity and semi-structure interviews, document analysis was also carried out.

4.7.2.2 Documents analysis

In addition to reflective activity and semi-structured interviews, document analysis, such as the KwaZulu-Natal Plagiarism Policy and Procedures, as well as the Turnitin Training document were collected to obtain the rich data. There are three traditions in document analysis which refer to primary and secondary documents as well as objects (Cohen et al., 2011a; McMillan & Schumacher, 2014). According to McMillan and Schumacher (2010), a primary document is any first-person narrative that defines an individual's action, experiences, and beliefs. Primary documents are diaries, letters, photographs, policy documents, e-calendar appointments, and minutes (Pearse, Rickard, Keogh, & Lin Fung, 2019). Secondary documents are formed through an analysis of primary documents to provide an account of the process in question (Cohen et al., 2011). On the contrary, objects are well-defined as created symbols and tangible entities that reveal social processes, meaning, and values (McMillan & Schumacher, 2010). Nakazawa and Ando (2016) add that the collection of documents with respect to an object which a user wants to analyse (referred to in future as "analysis object document') are collected−for example, a computer, laptop, telephone, and cell phone.

In case study research, researchers use documents as a data source, if contextual information about the process in question cannot be directly observed, and documents are also used by researchers to question information from other sources (Stake, 1995). Analysis of documents has been the most characteristic and traditional method used in modern history research, as distinct from social research (Cohen et al., 2011a). This study adopted the use of primary and secondary documents. The primary documents are a reflective activity, as are individual semi-structured transcripts. The secondary documents are the UKZN plagiarism policy and university plagiarism policies and laws based on the utilisation of Turnitin. These documents were analysed with the aim of identifying

and defining university laws and policies in terms of Turnitin utilisation (Mishra et al., 2010). I coded the documents and journals to allow linkage between the data contained within the primary and secondary documents (Boblin et al., 2013). In other words, I used the information gathered from reflective activity, individual semi-structured interviews, as well as UKZN policies and laws concerning plagiarism and Turnitin Training, based on natural settings. This was guided by the concepts of the TPACK theoretical framework. These concepts are rationale, vision, goals, assessment, content, and activities, methods, lecturers, resources, time and environment. Such assisted me in determining whether lecturers' understanding of Turnitin utilisation was channelled by these concepts. The document analysis was obtained from policy review and reflective activity. Recording of all data from interviews was in the form of transcription (Hashim, 2016), to have complete clarification in terms of lecturers' views. This understanding and interpretation contributed to producing themes and categories discussed in the next chapter. Therefore, document analysis, as a tool utilised for obtaining data, has an impact on the research and data analysis (Budden, 2017).

However, document analysis has its own drawbacks; for example, documents do not speak for themselves, but require careful analysis and interpretation (Cohen et al., 2011a; McMillan & Schumacher, 2014) . In addressing this issue, I carefully analysed and interpreted university laws and policies, and the data generated from this study against the studies concerning Turnitin utilisation. In addition, data analysis was performed simultaneously with data gathering. It might be difficult to analyse a document because of its length (Xu & Croft, 1996). During document analysis I gave myself enough time to analyse the document, gaining the relevant information guided by the research questions and themes framed around the theoretical framework TPACK. Pearse et al. (2019) confirm that analyses of documents require skimming, the initial preliminary exanimation to identify which document required more in-depth review; reading a thorough revision of selected document, as well as interpretation, including identification of emerging themes. Furthermore, in some cases, the document may have been forged. I have a responsibility to ensure the reliability of the document (McMillan & Schumacher, 2014). I ensured that I obtained the University of KwaZulu-Natal plagiarism policy, as well as the Turnitin training manual through the right channels; and also verified the authors, place, and the dates of publication (McMillan & Schumacher, 2010). Table 4.3 below displays how data was gathered.

Table 4.3: Data Generated Charts

	Objective 1	Objective 2	Objective 3
Why data were generated	Explore lecturers' understanding of Turnitin utilisation in assessing mathematics at a South African university.	Understand how lecturers utilise Turnitin in assessing mathematics at a South African university.	Understand the reason for lecturers' understanding of Turnitin in mathematics in particular ways at a South African university.
What was the research strategy ?	Reflective activity, document analysis, and individual semi-structured interviews.	Reflective activity, document analysis, and one-on-one semi-structured interviews.	Reflective activity, document analysis, and one-on one semi-structured interviews.
Who were resources?	Four lecturers from a mathematics department at a South African university.	Four lecturers from a mathematics department at a South African university.	Four lecturers from a mathematics department at a South African university.
How often was data generated?	Lecturers were given the reflective activity per email and collected similarly after two months. The one-on-one semi-structured interviews were conducted with each participant. The shortest interview took 1 hour and the longest interview took 1 hour 40 minutes. Lastly, the university plagiarism policy document was analysed and one of the Turnitin training manuals was analysed.	Lecturers were given the reflective activity per email and collected similarly after two months. The one-on-one semi-structured interview was conducted with each participant. The shortest interview took 1 hour and the longest interview took 1 hour 40 minutes. Lastly, the university plagiarism policy document was analysed and one of the Turnitin training manuals was analysed.	Lecturers were given the reflective activity which per email and collected similarly after two months. The one-on-one semi-structured interviews was conducted with each participant. The shortest interview took 1 hour and the longest interview took 1 hour 40 minutes. Lastly, the university plagiarism policy document was analysed and one of the Turnitin training manuals was analysed.
Justification plan used for data generation	The reflective activity enabled lecturers to reflect on their understanding of Turnitin utilisation based on their assessment practice in mathematics, without the pressure of the researcher, allowing them freedom to express their understanding. One-on-one semi-structured interviews assisted the researcher to obtain detailed as well as in-depth understanding of lecturers' utilisation of Turnitin in assessing mathematics. Document analysis assisted the researcher in obtaining details as well as in-depth understanding of how lecturers are expected to assess in mathematics utilising Turnitin.	The reflective activity enabled lecturers to reflect on their understanding of Turnitin utilisation based on their assessment practice in mathematics, without the pressure of the researcher, allowing them freedom to express their understanding. One-on-one semi-structured interviews assisted the researcher to obtain detailed as well as in-depth understanding of lecturers' utilisation of Turnitin in assessing mathematics. Document analysis assisted the researcher in obtaining details as well as in-depth understanding of how lecturers are expected to assess in mathematics utilising Turnitin.	The reflective activity enabled lecturers to reflect on their understanding of Turnitin utilisation based on their assessment practice in mathematics, without the pressure of the researcher, allowing them freedom to express their understanding. One-on-one semi-structured interviews assisted the researcher to obtain detailed as well as in-depth understanding of lecturers' utilisation of Turnitin in assessing mathematics. Document analysis assisted the researcher in obtaining details as well as in-depth understanding of how lecturers are expected to assess in mathematics utilising Turnitin.

4.8 Data Analysis

Data analysis assists in selecting the relevant information gathered while generating data, in order to gain a meaningful understanding of the phenomenon of the research (du Plooy-Cilliers, 2014b). This analysis is an inductive procedure of organising information into categories, and identifying, as well as making sense of patterns and relationships amongst those categories and themes (Cohen

et al., 2011a; McMillan & Schumacher, 2014) . The plagiarism policy, Turnitin training manual, reflective activity, as well semi-structured interviews were used in the study. In this study, data analysis started during the process of data generation (Cohen et al., 2011). According to Boeije (2010), the gathered data need to be managed so that they are ready to be analysed. To be able to administer, as well as to have an understanding of the generated data, a researcher needs to immerse him- or herself in the data, 'living' the data (Moser & Korstjens, 2018). In this way, the researcher is able to identify as well as to classify patterns and themes into categories (Given, 2008).

Based on the above literature, the data for this study was generated when the data were analysed, by drawing the interpretation from the raw data. The raw data were processed prior to analysis (Marshall et al., 2014). These data consisted of the UKZN plagiarism policy and procedures, Turnitin (TII) Training document, reflective activity, as well as individual semi-structured interviews. The first step I took was to analyse the policy and Turnitin manual documents. The UKZN plagiarism policy and processes document were gathered with the intention of finding out what the university stipulated about lecturers' utilisation of Turnitin in assessing mathematics. This policy was developed years ago. The first version was reviewed at Executive-Deans Forum on 2nd August 2007, authored by the Office of the Executive Director for Access, and has been used until the time this research was conducted. The policy has undergone different stages for approval. It was approved by the Structure Senate Council in 2009. The documents were analysed using the research questions and theoretical framework tool. These tools made it possible for me to examine the university Turnitin (TTI) training manual and plagiarism policy and procedures.

For the second step, I used the thematic method guided by an a priori analysis. For this method, I used a full transcription using Word per laptop, following the themes of the research questions and the concepts of TPACK framework in the form of questions. The data started with reflective activity following the concepts of TPACK. Moreover, face-to-face semi-structured interviews remained appropriate for investigating exploratory questions (Panahi, Watson, & Partridge, 2014). These questions assisted me to explore knowledge, opinions, and meanings that lecturers assign to their experiences by employing data collection and data analysis (Panahi et al., 2014). Data analysis was also carried out after the data transcription of the face-to-face semi-structured

interviews. During the interrogation process, I repeatedly read the voice recordings, going forward and backwards until I was satisfied that I had transcribed verbatim, every word of each individual semi-structured interview. Besides, in using the thematic method, I was able to find patterns in the data, by assigning codes to segments of text, translating the codes into higher-order themes (Riungu-Kalliosaar, Mäkinen, Lwakatare, Tiihonen, & Männistö, 2016). New themes that emerged from generated data were allowed (Wilson et al., 2016). This was in order to analyse the text as an accurate and true reflection of the interviews, including pauses, punctuation, and non-verbal data (Moser & Korstjens, 2018). This process involves selecting, organising, analysing, reporting, and interpretation of data, in which I was compelled to make informed decisions (Cohen et al., 2011a). Making the informed decisions about assigning codes and identifying categories, concepts, patterns and themes is based on analytic work by looking at the data at hand (Moser & Korstjens, 2018). Dhunpath and Samuel (2009) declare that data analysis can be guided in a prior way. Subsequent analysis guides the categories to be modified through interaction with the data (Dhunpath & Samuel, 2009). In the study, predetermined themes were created from lecturers' understanding; and were guided by the research questions. The themes were thus created from the three propositions of lecturers' understanding − professional understanding, private understanding, and public understanding. These propositions were modified through interacting with the data guided by the research questions as well as concepts of TPACK. These themes assisted in generating the information on lecturers' understanding of Turnitin, while categorising the concepts of TPACK in order to reach a meaningful conclusion (Makumane, 2018). Table 4.2 below shows the categories guided by research questions and the TPACK framework.

Table 4.4: Categories Guided by Request Questions Proposition and Concepts of TPACK

	Proposition	Categories in Levels
1. Content and Activities	Geometry Algebra Geometry	Professional understanding Private understanding Public understanding
2. Assessment	Summative Formative Peer	Professional understanding Private understanding Public understanding
3. Resources	Hardware Software Ideological-ware	Professional understanding Private understanding Public understanding
4. Procedures	Product Process Critical	Professional understanding Private understanding Public understanding
5. Roles	Instructor Facilitator Collaborator/ Researcher	Professional understanding Private understanding Public understanding
6. Platform	Face-to-face/Inside Outside Inside and outside/ Blended	Professional understanding Private understanding Public understanding
7. Intervals	Hours Days Weeks	Professional understanding Private understanding Public understanding

However, one of the shortcomings of data analysis is that it is time-consuming (Cohen et al., 2011a). Wilson et al. (2016) assert that full transcriptions of all interviews are important to avoid bias introduced through selective data withdrawal from the study guided by particular themes. In addition to Wilson et al. (2016)'s contribution, I used the participants' quotations in order to avoid bias in the conducted interviews. The analysis of a transcription poses some difficulties. In this process, I was able to examine the transcripts for meaning and essential patterns, generating genuine and insightful findings (Moser & Korstjens, 2018). According to Cohen et al. (2011b), the qualities of the researcher, such as understanding of the field being studied, and experiences in the research, can influence the data-analysis process. To avoid interference in the study, I went back to the participants for validation of the results before I wrote the conclusion. The data analyses from reflective activity, document analysis, and semi-structured interviews, ensure trustworthiness.

4.9 Trustworthiness

In qualitative research, the following concepts are used for issues of trustworthiness, namely: credibility, dependability, transferability, and confirmability, to ensure the quality of the findings (Cohen et al., 2011a).

Credibility is an organised process, in that the reviewer writes an analysis after carefully studying the documentation provided by the research (Creswell & Miller, 2000). I used multiple methods, such as reflective activity, document analysis, and semi-structured interviews and recordings, that led to more valid, credible, and varied construction of realities (Golafshani, 2003). To achieve credibility in this study, the same questions for reflective activity document analysis, and semi-structured interviews were used. Results were generated and taken as participants' viewpoints in the research. However, one of the shortcomings in establishing credibility is the researcher's personal worldview, and individual biases that may influence the study. I was aware of this factor, and guarded myself against interposing bias in the research (Kolb, 2012).

Trustworthiness in any effort to increase **dependability** involves consensus and conformity in the analysis of the data, which is usually at the expense of the meaningfulness of the findings (Rolfe, 2004). Dependability also agrees with the idea of trustworthiness which promotes repeatability (Wahyuni, 2012). I achieved dependability by presenting a full explanation of the research process during data gathering. I provided the main methods of gathering empirical data, for example, the

content of questions that were used during the data gathering. The evidence gathered from the reflective activity, face-to-face semi-structured interviews, and document analysis, confirmed dependability. The study used the same questions guided by the concepts of TPACK for the above-mentioned methods. The use of reflective activity, document analysis, and semi-structured interviews, recordings from the audio recorder, and direct quotations led to more valid, trustworthy, and diverse construction of realities (Golafshani, 2003).

Besides, in qualitative research, the study must accurately describe the findings of the phenomenon being researched (Cohen et al., 2011a). I listened carefully and repeatedly to the recording, transcribing the information as it was, thus accurately describing lecturers' understanding of Turnitin utilisation. Furthermore, after each transcription, I went back to the participant for cross-checking and validation before writing the results and findings of the study. This was in order to have the same understanding of concepts from the participants' point of view, to ensure dependability. In that respect, I avoided bias, by using the quotations of the participants to provide the empirical evidence. Transferability is the capability of transferring the findings to the same context, to provide the same results (Koonin, 2014). In this study, a rich and thick description was generated from the lecturers who participated, by means of reflective activity, individual semi-structured interviews, document analysis, recordings from the audio recorder, and direct quotations. This allowed individuals to evaluate the conclusions drawn, which could be transferable to other settings (Pandey & Patnaik, 2014). Sites and characteristics of case organisations was provided to ensure transferability. The results of this may be transferable to the same context. However, for transferability in this study I described the procedure adopted while the research was carried out for the researchers who might be interested to follow and replace, but they should not expect to find the same results.

Wahyuni (2012) states that **confirmability** refers to the extent to which others can confirm the findings in order to check that the results reflect the understandings and experiences from participants, rather than the researcher's own preferences. In light of this, the data gathered from reflective activity, individual semi-structured interviews and document analysis were verified by the participants, approving the data (Cohen et al., 2011a) . Documentation on data and progress of research was carefully kept in the form of research memos and temporary summaries as part of the research work-book. The study ensured that validity and credibility, multiple and diverse realities,

as well as multiple methods of the gathered data, were in order. Providing false information would affect the accuracy of the findings of this study. In dealing with this issue, I clearly explained the purpose of the research, confirmed by using the gathered data from reflective activities, semi-structured interviews, as well as document analysis. to ensure accuracy.

4.10 Ethical Issues

McMillan and Schumacher (2010) state that researchers must adopt ethical principles, which include policies regarding informed consent, confidentiality, anonymity, privacy, and caring. Cohen et al. (2011b) add that ethical issues may stem from the kinds of problems explored by social scientists and the procedures they use to acquire authentic and dependable data. Furthermore, Cohen et al. (2011a) emphasise that the examiner is accountable for considering the effects of the research on participants. The researcher must therefore act accordingly, to maintain the dignity of the participants as human beings. A letter was written requesting permission to access the university facilities. The university, in return, granted me such permission per letter (see Appendix 5). I also wrote a letter requesting permission from the registrar's department to conduct the study at the selected site (see Appendix 3). On approval of the research, I contacted the participants via telephone, in person, and in writing, requesting that they participate in the study. Therefore, in this study, I followed ethical principles to avoid ethical issues that might arise. Permission was requested verbally, followed by writing a letter to the participants (Appendix 4). As the aim of the study was to examine lecturers' understanding of Turnitin utilisation at a South African university, the most convenient place to conduct the research was the university.

In reaching the agreement with the participants, I updated them verbally, and in writing, on the whole process of the research, confirming their protection against any harm that might arise during the research. I also explained verbally and in writing the intention of the research study; and that the data generated was to be used for the purpose of the study only. Moreover, I updated all the participants who had experience on the study on their rights to confidentiality, anonymity, and the right to withdraw from and re-join the study at any time (Cohen et al., 2011a). Moreover, I informed the participants that no financial gain would be had for participation. Instead, I explained to prospective participants that the case study might help them gain understanding, and improve their practice of Turnitin utilisation. To ensure privacy, participants were assured of the use of

pseudonyms. Further to this, after being satisfied that the participants were clear about the whole process of the study to be conducted, the consent forms were given to the participants who agreed to participate. Participants were given time to read the consent forms. The participants then signed the consent forms in order to carry out the research. In addition, I kept on checking whether the participants were still willing to continue. The participants insisted that they were willing to participate in the study. In that case, the above-mentioned ethical principles might limit, if not fully eliminate, the ethical problems.

4.11 Anticipated Problems/Limitations

There is no research without limitations (Marshall & Rossman, 1999). I acknowledged that, since I am not a lecturer, it was not easy to find lecturers to participate in the study. I am a doctoral student. I acknowledge that I have my personal expectations concerning this research, which might lead to prejudice. In overcoming this limitation, I tried to listened to the participants without interfering in the research. The participants were allowed to provide their own information without being influenced during data generation and data analysis. In addition, participants might enter the field of the study with all their information on the research, deciding to withdraw during the process of data generation. To deal with this issue, I ensured that I had more participants than the required number to participate in the study, to avoid such disappointment. In addition, of the proposed seven participants for this study, only four participants accepted my request. The other three were not willing to participate for personal reasons. There was a delay in conducting interviews because of some lecturers' commitments in attending workshops and conferences. I had to be patient; as Yin (2011) argues that, in studying real-world events, they assume their own natural course, and may alternatively present unpredicted resistances and limitations. Moreover, the study had the intention to use one-on-one semi-structured as one of its data-generation techniques, was used not for personal reasons but used for the purpose of this study. The observations were replaced by reflective activity. Another limitation of this study was that, since the study used a small number of participants, the findings and results cannot be generalized. Thus, the purpose of this study was to gain rich and thick data rather than generalisations.

4.12 Summary

Discussed in this section were the research methodology, research paradigm, research style, sample and sampling techniques, gathered data, reflective activity, face to face semi-structured interviews, document analysis, data analysis, and trustworthiness. Finally, the chapter concluded by discussing ethical issues and limitations that threatened credibility of this research. The next chapter presents and analyses findings from data gathered in this study.

CHAPTER 5: DATA PRESENTATION AND ANALYSIS

5.1 Introduction

Chapter 4 of this work focused on the research design and methodology employed for data generation with the purpose of addressing the objectives and research questions that guided the study. In this chapter, the data generated through semi-structured one-on one interviews and reflected activities and policy document, are represented and analysed. Data was taken from lecturers in the department of mathematics, with the aim of addressing the research questions posed in the study, namely:

5.1.1 What are lecturers understanding of Turnitin utilisation in assessing mathematics at a South African university?

5.1.2 How do lecturers understand utilisation of Turnitin in assessing mathematics at a South African university?

5.1.3 Why do lecturers understand utilisation of Turnitin in assessing mathematics in particular ways at a South African university?

As indicated above, the data were generated using three methodological tools for triangulation and to reduce any form of prejudice. To resound with the case study and for its purpose to be accomplished, it was essential to gain the in-depth meaning of the participants' interpretation of the real world. The study accomplished these meanings and interpretations by using reflective activity, semi-structured interviews, and document analysis. The exploration of lecturers' understanding of Turnitin utilisation in assessing mathematics was achieved to provide an in-depth overview of such. This chapter is divided into three sections −A, B and C. Sections A and B focus on answering research questions One and Two of the 'What and How', respectively. The C part of the 'Why' is presented in the following chapter. These questions are addressed through the themes and propositions following curriculum concepts. The figure below shows the summary structure of the data presentation and analysis.

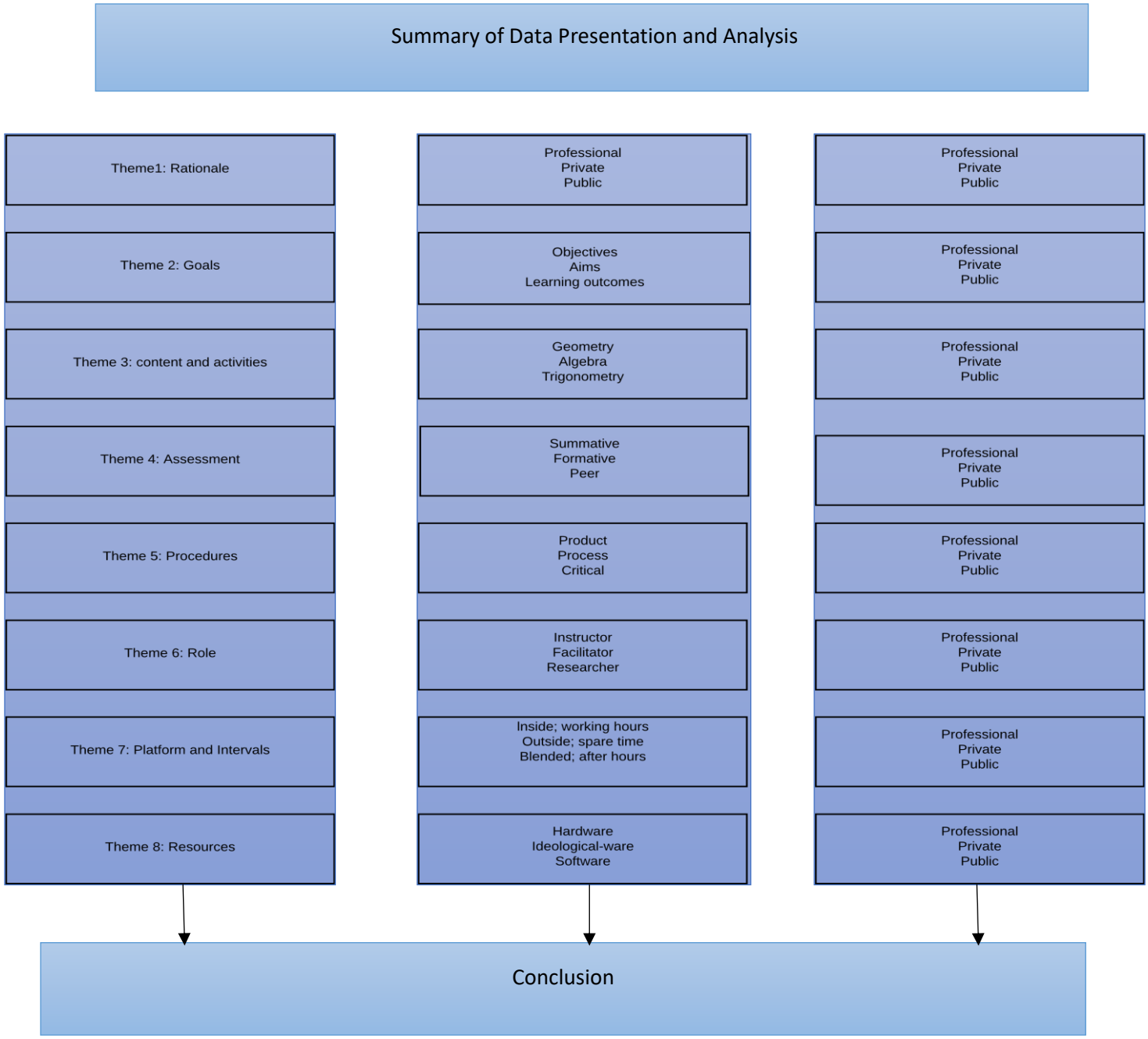


Figure 5.1: Summary of Data Presentation and Analysis

SECTION A: RESEARCH QUESTION ONE

This section presents findings on research question one which addresses the *what* question, namely:

What are lecturers understanding of Turnitin utilisation at a South African university?

5.2 Findings and Discussions

This section presents the data that were generated on lecturers' understanding of Turnitin utilisation, for discussing the findings. For Anderson (2010), the findings, including the discussion of literature, should be presented in the context of any similar previous research or theory (Anderson, 2010). In this study, the presentation of the findings is interpreted on reflective activity, semi-structured interviews, and document analysis. The findings are presented according to the themes, supported by direct quotes from the participants (Bennett, Dawson, Bearman, Molloy, & Boud, 2017). The reviewed literature was used for supporting the discussions and findings. The responses are presented, discussed, and interpreted for each participant. They are then fused, in order to present a holistic in-depth overview of lecturers' understanding of the themes generated from reflective activity and interviews.

5.2.1 Theme 1: Rationale

Why do you understand utilisation of Turnitin in a particular way?

Rationale, according to this theme, means the reason for lecturers' understanding of Turnitin utilisation in assessing mathematics. All four participants shared their understanding on their rationale of Turnitin utilisation in the assessment of mathematics. This is evident by the comments generated through reflective activity and interviews.

Lecturer 1

> *"…Turnitin is used to catch students who have plagiarised …Turnitin is used to catch students who have plagiarised…She added that there are times where I do not trust my students…I don't rely in Turnitin, I as a Lecturer, in mathematics…I check work of students myself...I can tell if a student has plagiarised because I know my students …Turnitin is an easiest way of reaching a number of students in a short period. …Turnitin promotes integrity amongst students (Lecturer1)".*

Turnitin is used to detect plagiarism. Lecturer 1 added that she does not rely on Turnitin. She added that Turnitin assist checks many papers in a short time.

Lecturer 2:

> *"Turnitin is utilised to check similarities* "*Turnitin check whether students have plagiarised or not …but I don't use Turnitin on mathematics education because in most cases they apply their knowledge… I use it on postgrads only…Turnitin is a tool used to control students to be creative enough to use their own ideas instead of others… I do not give student the work that require them to go to Internet (Lecturer 2)".*

The comment from Lecturer 2 above indicates that Turnitin checks whether the work submitted by a student is copied from other scholars. In her case, she does not use Turnitin on mathematics because students apply their knowledge. She also added that this encourages students to become creative enough to use their own ideas.

Lecturer 3:

> *"…Turnitin check the plagiarised work "…. Is a software used for checking whether students have plagiarise… but in terms of assessing Mathematics, I don't have knowledge of how to assess using Turnitin…Once they are done uploading their paper to Turnitin, then Turnitin checks via world wide web (www) whether they have copied or how much they duplicated (Lecturer 3)"?*

Reference from comments above suggest that the Lecturer 3 is aware that Turnitin checks the plagiarised work. She added that Turnitin checks whether students have repeated the work of others.

However, Lecturer 3 indicated that she has never used Turnitin.

Lecturer 4:

> "*Turnitin is utilised to check if students did not copy from the Internet", but for mathematics it is difficult to pick up that because there is one way to do mathematic sand students use one or two ways of proving…let say it is a theory. Student one might use method 1, student two might use method 3 but come with one answer (Lecturer 4)".*

Lecturer 4's comment indicates that Turnitin is utilised to detect plagiarism, but she is doubtful whether Turnitin is effective in assessing mathematics. She also argued that, in mathematics, methods may differ, but there is one correct answer.

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Lecturer 4:

> "*…it is important to encourage lecturers and students to use Turnitin as a formative tool to help academic writing…Turnitin is a software that compares students work with existing written work from the web pages, previously submitted assessments, library database and publication… It detects similarity; it does not detect honest or dishonesty…It is up to you and ultimately the person marking your work, to judge whether it demonstrates an appropriate level of originality and academic and honesty…. Utilising Turnitin is intended to facilitate the process of ensuring academic integrity, which includes the work or ideas of others…Turnitin assists students applying their own ideas and to produce their own original work Turnitin cannot critique GeoGebra for example (Lecturer 4 ").*

Analysis from the comments above indicates that Lecturer 4 is aware that Turnitin checks the work of students against the work that was previously submitted on the Web page, database, and published work. Lecturer 4 also stated that Turnitin works as a formative tool. Lecturer 4 further

stated that Turnitin is utilised to avoid plagiarism, which includes ideas of others, indicating professional, private, and public understanding. Turnitin assists students to learn to use their own ideas, indicating personal understanding. However, Lecturer 4 argued that lecturers should not rely on Turnitin. They should use their experience and manual detection, because Turnitin was not accurate.

Based on the above excerpts, it is evident that all four lecturers shared the same rationale of understanding Turnitin utilisation in mathematics. They commented that Turnitin is used to detect students who copy other people's work, indicating professional understanding. However, they explained this differently. Lecturer 1 commented that, even though Turnitin marks many papers in a short time, she does not depend on it. She reads students' work herself because she does not trust the students. She can tell whether students have plagiarised, knowing every writing style of her students, indicating professional, private, and public understanding. Lecturer 2 said that Turnitin is not applicable to mathematics education because students apply their knowledge, indicating personal understanding. Lecturer 3 said that she had no idea of assessing utilising Turnitin, but theoretically has understanding of Turnitin utilisation. However, Lecturer 4 indicated that Turnitin does not work for her since she is teaching pure Mathematics. She has understanding of how Turnitin works, indicating that Turnitin might detect honesty or dishonesty. Lecturer 4 added that it depends on the lecturer's judgment whether the student has plagiarised or not, indicating personal understanding. Lecturer 4 further stated that Turnitin cannot critique other software such as GeoGebra. Lecturer 1 showed professional, private, and public understanding, while Lecturers 2 and 4 reflected personal understanding when indicating that Turnitin encouraged students to use their own ideas.

5.2.2 Theme 2: Goals

What do you understand about utilisation of Turnitin?

Goals involves aims, objectives and outcomes. All four lecturers shared their views on the objectives, aims and outcomes of the utilisation of Turnitin software in the assessment of mathematics. This can be confirmed by their various comments below. At this stage the participants were expected to reflect according to three perspectives, as indicated above.

Lecturer 1:

> "…*Is to assist students to do away with coping other people work" …Student are smart on in such a way that you cannot trust them. But I don't use it to assess mathematics…I think to teach student about Turnitin is dangerous because sometime students use it against us…Like one of my previous student who copied a work from china and translate it in English…As a result, that student was expelled from the university…That is why sometimes I decide to keep quiet about it…The purpose of Turnitin is to check plagiarism…but I don't use it to assess mathematics… I mark myself (Lecturer 1)".*

Lecturer 1 maintains that Turnitin prevents students from copying other people's work. At the same time, she also argues that teaching students about Turnitin might be dangerous, because there are students who manipulate Turnitin so that they cannot be caught for plagiarism. Lecturer 1 further added that Turnitin is utilised to check whether students had copied one another.

Lecturer 2:

> *"…. understanding is to check similarities … I do my own assessment; I mark students' work for myself. "If I suspect that the work is plagiarised work I discuss with that particular student if there is a need the will redo the assignment…I want promote and honesty and independency to students…If Turnitin is to be utilised in Mathematics, then all students will be picked up for plagiarising. Turnitin should be upgraded to be able to recognise symbols and formulae (Lecturer 2)".*

According to the comment from Lecturer 2 above, Turnitin checks similarities. Turnitin promotes honesty and independence. Turnitin can flag students' work in mathematics. Turnitin informs lecturers of plagiarised work; Turnitin indicates whether students need to redo their work.

Lecturer 3:

> "*I understand Turnitin as a software for checking whether students have not been plagiarising …Turnitin has a tendency of picking up the previous work so it better to mark the work myself… to assist students to produce their original text…and again I think it is better to submit chapter by chapter instead of submitting the whole theses at once… but in terms of assessing mathematics…I don't have knowledge of how to assess using Turnitin (Lecturer 3)".*

Lecturer 3 agrees that Turnitin checks whether students have plagiarised. Turnitin picks up the work that has previously been uploaded to the database, the Internet, and the library. This implies professional and private understanding.

Lecturer 4*:*

> *"Its use will allow academic staff, students and other members of the university community to gain confidence that work which they submit as original meets the criteria of a high level of originality…Turnitin is useful in class to discourage plagiarism and to make it easier to identify plagiarised work…Plagiarism is the results in the lack of academic writing needs and lack of a deep learning approach. It is important to encourage Lecturers and students to use Turnitin as a formative tool to help academic writing…but for mathematics it is difficult to pick up that because there is one way to do mathematics (Lecturer 4)".*

Lecturer 4 confirms that Turnitin assists university staff members, students, and community members to submit the original work that that is required of them. Turnitin identifies plagiarised work, and discourages plagiarism. Turnitin should be used as a formative tool.

Based on the above extracts from all lecturers above, the findings indicated that all lecturers are aware that Turnitin checks whether students have plagiarised or not, although lecturers put this differently, indicating professional understanding. Lecturer 1 added that Turnitin prevents students

from copying other people's work. Lecturer 2 said that Turnitin checks similarities, indicating her professional understanding. Lecturer 3 said that Turnitin checks whether students have plagiarised, indicating professional understanding. Lecturer 4 declared that Turnitin identifies plagiarised work and discourages plagiarism, displaying professional and private understanding. However, lecturers also had different views concerning Turnitin. Lecturer 1 indicated that, in teaching students about Turnitin, some students might learn to manipulate it; this is why she has decided to ignore Turnitin. Lecturer 2 shared a different view, stating that Turnitin promotes honesty and independence in students, showing private understanding. She added that, for mathematics, Turnitin does not work, because it always shows that student have plagiarised. Lecturer 2 further added that Turnitin determines whether students have to repeat their assignments. She also recommended that Turnitin be upgraded to recognise formulae and symbols. Furthermore, Lecturer 3 indicated that Turnitin highlights all the work that has been plagiarised from the Internet and the database. Lecturer 4 commented that Turnitin assists staff members, students, and community members to ensure that they submit original work, indicating professional and public understanding. Lecturer 4 also indicated that Turnitin develops students' academic writing, and channels students to learn more profoundly, indicating professional and private understanding. Only Lecturer 4 shared the understanding of professional, private, and public understanding. However, all lecturers indicated that they were not implementing Turnitin.

SECTION B: Research Question Two and Three

This section presents findings on the second research questions which focuses on the *how question*, namely:

- How do lecturers understand utilisation of Turnitin at a South African university?

5.2.3 Theme 3: Content and Activities

What content and activities are you assessing?

Content, according to this theme, applies to the concepts that are taught and assessed in mathematics, whilst activities imply the action executed together with what is learnt. All four lecturers shared their understanding on how Turnitin is used in the assessment of content and activities in mathematics. This is evident in their comments below.

Lecturer 1:

> "*As you know teaching and learning has to be interactive…Therefore, content and activities can be seen through presentation and face to face…At times when I don't want to deal with Turnitin I let them do portfolios and flowchart…In mathematics there is a challenge of using Turnitin, like numbers, symbols…some Language in mathematics cannot be translated, terminology is a challenge…Turnitin should be able to translate all languages (Lectuer1)".*

Findings from the analysis of the comment shared by Lecturer 1 in the above statement indicate that utilising Turnitin in the content of mathematics is a problem, since the language and the terminology cannot be translated. This lecturer suggested that translating features be included in Turnitin software. She also indicated that the activities given to students deal with presentations, flowchart, portfolios, numbers, symbols, language, and terminology used in mathematics. Lecturer 2 put forth her views on content and activities.

Lecturer 2:

> *"Since I deal with methods in mathematics, I allow students to critique the lesson plan, they bring along the lesson plans and critique it, they apply their understanding" …I request students to critique the lesson plan and the observed lessons, as well the teaching materials… I don't use Turnitin (Lecturer 2)".*

From the analysis of the excerpt above, Lecturer 2 assesses the content that allows students to critique lesson plans, observe lessons, while also critiquing the teaching materials. Students use their knowledge to critique a lesson. The lesson plan, the observed lesson and material that is critiqued includes common language, terminology, numbers and symbols. Hence the lecturer feels no need of utilising Turnitin.

Lecturer 3 agreed with Lecturer 1, although she added symbols and numbers in her comment that:

> *"Most of writing is in symbols and numbers and the mathematics language. In my work they apply theory … References are excluded when students have to submit on Turnitin …In maths we deal with symbols except if it is a kind of method.*

Mathematics has common symbols, language and terminology…In my module I give students short assignments. (Lecturer 3)".

The comment above made by Lecturer 3 indicates that the content of mathematics, in most cases, is given in symbols and numbers, as well as a common language and terminology. Students are given short assignments. Except for a method like the one she is teaching, students apply theory. This theory is applied to the content that was taught and the material that was used then. References are also a part of content that Turnitin deals with it, but this lecturer is aware that Turnitin can exclude references, even though she does not utilise Turnitin.

Lecturer 4:

"When I doing graphs, the student draw, they don't type in most cases. If I say to students they must prove theorem that read thus the angle tangent between the cord is equals to the angle with alternate circle, show all the construction the student will use the GeoGebra and everything will be the same way. If the angle is 60 GeoGebra will show 60 the student will get 60 prove that …When they do data handling, prove the theorems, practical work…they might go and observe the lesson and critique a lesson so they use their own thinking. The students are supposed to critique what they observe, if they google they observe lessons from google form software…therefore Turnitin does not work in mathematics (Lecturer4)".

The comment made by Lecturer 4 above indicates that she assesses graphs, draws angles, proves theorems, handles data, and constructs angles using GeoGebra, while also observing and critiquing lessons from Google Form software.

From the analysis of the above excerpts, it is evident that all four lecturers share similar understanding on the use of content in Turnitin utilisation. However, Lecturers 1 and 3 commented about language and terminology in the content of mathematics. Lecturer 1 differs from Lecturer 3 in her comments, adding that she gives students portfolio flowcharts and allows students to make presentations. While Lecturer 3 talked about numbers, symbols, and the application of theory,

Lecturer 2 stated that, in the content, students critique lessons plans, observing and critiquing lessons presented. Conversely, Lecturer 4 stated that the content involves graphs, angles, data handling, and theorems.

Based on the above comments, it is evident that Lecturers 1, 2, and 3 have similar understanding of the content when commenting on numbers, symbols, language, and terminology involving algebra in mathematics. For example, lecturer: "Lecturer 4 commented about graphs, data handling, construction of angles, and proving of theorems, involving algebra, geometry, and trigonometry. For instance, *when they do data handling, prove the theorems, practical work…they might go and observe the lesson and critique a lesson so they use their own thinking.* Lecturer 4's comments expressed professional, private and public understanding. These similarities indicate professional understanding concerning the content knowledge of mathematics. It was evident that lecturers were aware that mathematics content is the similar, there is no way that a lecturer might detect plagiarism.

5. 2.4 Theme 4: Assessment

How do you assess mathematics utilising Turnitin?

Assessment in this context means marking, using Turnitin, the work, projects, or assignments that have been given to students. Lecturers are expected to touch on formative, summative, and peer assessment. The four lecturers shared their understanding below.

Lecturer 1:

> "*I mark for myself, and I know that student can manipulate Turnitin…No assessment is done on Turnitin...I rather give them tests, portfolios, let them do presentation, than using Turnitin…In most cases they copy assignments but not during the examination, because they know the rules…I mark papers from UNISA…I know most of the papers…If it happened that a student got 50% similarity might be chased away from the university…If it happens that I find out that student has plagiarised…I warn them or if I feel pity for them…I tell them to*

start again because if the university catches them the offense they can get is to be chased out of the university (Lecturer 1)".

Reference to the comment above indicates that Lecturer 1 assesses students' work through tests, portfolios, assignments, presentations, and examinations, using manual detection. She admitted that plagiarism occurs, but not during examinations. Should plagiarism occur, the relevant student would have to redo the work. She further added that students are aware of the measures taken if irregularities happen during examinations. She also added that plagiarism does not occur during the examinations.

Lecturer 2:

"I assess student understanding, they critique the method of teaching and the material. I am able to pick up students work if it happened that they copy. Usually there is one answer for mathematics. Those who got it wrong step by step its where I notice then I call a student and discuss, at times I divide marks by a number of students then they got the same mark or let the student redo the assignment, but on the exams I don't give assignments. I mark students' work with the help of tutor (Lecturer2)."

The comment above indicates that Lecturer 2 assesses students manually with the help of tutors. The lecturer assesses and marks students through critiqued lessons, lesson plans, materials, and assignments. There are examinations given to students that count for a final mark. The lecturer is able to notice plagiarism should it occur. She added that she gives any guilty student the chance to rewrite the assignment. If there a group of students' work is suspected to be plagiarised, only one paper is assessed. The mark given to that student is then divided among all those students who found plagiarised or divide the marks by the number of students who copied the same work.

Lecturer 3:

> *"I use a rubric or a memorandum for marking… I do read the work myself, mark it myself, if I see similar staff as a knowledgeable person, I would inform them before I might not know everything once I am satisfied, I will give a go ahead then they put it on google form which is another form that actually checks." I do give tasks every week (Formative assessment). I also give them assignment inside the lecture where the class marked (Peer assessment). Then test and exams (summative assessment"). I use google form I pre-load the answers like yes or no and there is a rubric used…Google form checks and give student feedback to students via or to Moodle as a way of assessment…Types of assignments, Tutorial assignment, tasks, test and exams (Lecturer 3)."*

This lecturer uses a rubric to mark; instead of Turnitin she uses Google Form software. Lecturer 3 states that she assesses through tutorial assignments, weekly tasks, tests, and examinations. Furthermore, she uses Google Form when assessing and marking. In return, Google Form gives feedback to students, per pre-loaded questions and answers, or rubric. In addition, Lecturer 3 also allows students to mark in class.

Lecturer 4:

> *"…personally mark students' work I set a paper myself. I give feedback to student personally. The use of Turnitin, promotes student learning outcomes with significantly improved academic skills in a language…most of the work is practical in mathematics… at times I mark tasks with student in class…so that I can correct them there and then at the end of the year I give them exams…No way I can be able to pick up plagiarised work in mathematics (Lecturer 4)".*

Comments above demonstrate that Lecturer 4 assesses though manual detection. Students are given practical work and examinations. Lecturer 4 also involves students during marking. Lecturer 4 marks in class in order to correct students there and then. Even though she is aware that Turnitin promotes students' academic skills, she thinks that Turnitin is better for languages.

Grounded on the analysis of the above comments, it is evident that all lecturers shared similar understandings in the assessment on manual detection. However, there are different types of assessment, as outlined in the various comments below. For example, Lecturer 1 stated that she assesses student through tests, portfolios, assignments, and examinations, using manual detection. She added that students are aware of the measures taken if the irregularities happen. Such does not occur during examinations. Lecturer 1 takes measures if plagiarism occurs on assignments, or portfolios. In addition, Lecturer 2 stated that she assesses student manually with the help of tutors. Furthermore, Lecturer 2 marks the critiqued lessons, materials and assignments, and there are examinations given to students. Moreover, Lecturer 2 is able to detect plagiarism should this occur. She added that she gives students another chance to rewrite the assignment or divide marks by a number of students who must have been caught plagiarised. Similarly, Lecturer 3 commented that she uses a rubric from which to mark. Instead of Turnitin she uses Google Form software, giving students feedback. Students are assessed weekly, and given tutorial tasks. Lecturer 3 also allows students to mark. Moreover, she gives students tests and examinations. Lecturer 2, 3, and 4 agree with Lecturer 1 that they assess manually. Lecturer 3 also stated that students are assessed on practical work and examinations. Lecturer 3 also involves students during marking. This concludes that all four lecturers are aware of formative, summative, and peer assessment in assessing mathematics. In other words, they all have an understanding of professional, private, and public understanding in assessing mathematics, even though they do not utilise Turnitin. Lecturer 3 did, however, mention that, instead of Turnitin, she uses Google Form to mark students' work.

5.2.5 Theme 5: Procedures

What methods do you use in assessing utilising Turnitin in mathematics?

Procedures in this context mean the procedures that are followed utilising Turnitin in the assessment of mathematics. All participants shared their understandings on the procedures as confirmed in various comments below.

Lecturer 1:

> *"I never teach them how to use Turnitin because they know why it is used, I do not think they learn from that experience. The only method I use is to ask them to submit*

to Turnitin. The only method it is done when students have submitted their assignments. I mark them personally. I read every student paper thoroughly, if I suspect the student it is only then that I call the student and discuss the paper, try to understand what is going on with that particular work…. if there is a need to assists students, I do… If it happens that I find out that student has plagiarised… I read the university policy concerning plagiarism…I give them warning or if I feel pity for them, I tell them to start again…or deduct marks from student's work…if it happened that a student got 50% similarity might be chased away from the university (Lecturer1)"

Findings from the comment above show that Lecturer 1 marks personally. She reads every student paper. If there are any suspicions regarding plagiarising from students' papers, she calls the student and discusses such with that particular student. In addition, she reads out the university policy which lays down all the rules and procedures concerning plagiarism. Lecturer 1 adds that she advises that particular student to redo the work or she will deduct marks from the student's work. She tells the student that anyone who plagiarises fifty per cent or more risks being expelled from the university. Furthermore, Lecturer 1 commented on colour codes generated by Turnitin.

Lecturer 1:

"Turnitin generates a report with colours, like red shows high risk of similarity, I should take note of that work. There are more articles similar from the same university… it might happen that, the issue that is addressed has been written by many students…The students have to go back to the article and minimise what has been said by such scholar, make his or her own original idea. Green means you are on the go, there is no problem but it depends how much greens do you have…brown has its own meaning, if there is too much brown it will change to red… If there is too much red, then it means the lecturer has to take care of it…I don't need to worry about Blue. If one feels like there is nothing to change don't because there are words or work that does not need to be change… (professional understanding) For

example, how can you change the word chapter, number or a fraction …There is no need to include references when sending the work to Turnitin (Lecturer 1)".

The analysis from comments above indicates that Lecturer 1 is aware of the colour codes that are produced on a Turnitin report. Lecturers should pay attention to the report, examining the colour codes. Red indicates a high risk of similarities, therefore the lecturer must scrutinise such work. Green gives the green light to proceed because there is not much similarity. The amount of green showing is, however, significant. Brown has its own meaning. If Turnitin shows too much brown there is a possibility that it might turn into red. Lecturer 1 further states that, if Turnitin shows the blue colour, it means that the similarity is acceptable. Moreover, the participant argues that words or numbers do not need to be changed. Lecturer 1 made an example of a word chapter and fraction. She also recommends exclusion of references when uploading work to Turnitin.

Lecturer 2:

"…teaches methodology in mathematics…I let them critique the lesson plan, apply their understanding…At time they critique the lesson taught in class or any given material…I allow them to present a lesson in the lecture room and critique one another…assist students if it is necessary. We do mark students' work ourselves…We come together with other colleagues divide the students' assignments and mark it ourselves…If we suspect plagiarism we call a student, or group of students if it happen that they worked as a group and shared the assignment or a task to find out what happened...read the university policy and the rules concerning plagiarism…let the student or those students concerned redo the work or divide the marks according to their number…this happens on tasks and assignment not on exams…I also assist students who encounter problems on their studies (Lecturer2)".

With reference to the comment above, Lecturer 2 allows students to critique the lesson plans, lessons taught, and materials (process understanding). Students are given a chance to critique one another. Lecturers who are teaching mathematics education share student papers for marking. The

colleagues share the information on students' work (critical understanding). If they suspect that plagiarism has taken place, they call the student or students involved to discuss the suspected work. After confirming that students have plagiarised, the lecturer compels students to read the plagiarism policy, warning them, and allowing them to restart the work; or she deducts marks from students Productive understanding. Lecturer 2 further explained that this has happened on assignments and tasks only, not during the examinations.

Lecturer 3:

> *"…. understanding is that once I am done with the paper, I create a class with the end date, add assignment to accommodate students who are close for submission…I assist those students who are experiencing challenges during the weekend… for them to be able to upload their work I create a page for google form so that students are able to upload their work but not for Mathematics…For Mathematics I mark with my colleagues, we give feedback on, the presentation, lessons plan, lessons observed. …I create google form in google form I create a solution and how many program it in such a way that there is a limit where students have a limit to attend that particular task…In my module I give students short assignments…My understanding with Turnitin is that if you have more than forty words one has to put inverted commas, if it is a direct quote… (Lecturer 3)".*

Lecturer 3 in the comment above shared the views of Lecturer 2, stating that she allows students to submit their work. They share the submitted work so that they do marking together. After marking they give feedback to students. In addition, she stated that she assists students who are experiencing problems with their work. However, Lecturer 3 is aware that, to have access to Turnitin, an account must be had with Turnitin with an end date, adding an assignment before the submission. She does not use Turnitin in assessing and marking mathematics, but her understanding about Turnitin is that if there is a direct quote of about forty words, one has to use inverted commas.

Lecturer 4:

> *"I mark it myself there is no need to utilise Turnitin in mathematics… at time I mark it myself, I use a memorandum or rubric for marking…give feedback…and there is a lecture room to help those who experience problem… I deal with graphs, and theorems… students draw graphs, using a pencil…the nature of mathematics does not allow students to type it…Turnitin has no relevancy in what I am teaching… (Lecturer 4)".*

From the excerpts above, Lecturer 4 does not use Turnitin. She marks the work of students herself, using a memorandum or rubric. She also states that she gives feedback and assists those who are facing challenges in mathematics. She further claims that what she is teaching does not allow students to type; for example, when they have to draw graphs, they use pencils.

Based on the findings above, it is evident that all four lecturers do mark the work of students referring to the memoranda or rubric, using manual detection, and giving feedback to students. There is evidence from lecturers' expressions that they do assist students if they encounter problems. For example, Lecturer 1 said: "*…. if there is a need to assists students, I do".* Lecturer 2: "…*I also assist students who encounter problems on their studies (lecturer 2)"*. Lecturer 3 stated: "*I assist those students who are experiencing challenges during the weekend (Lecturer 3)",* and Lecturer 4 said she uses "…*a lecture room to help those who experience problem*" (Lecturer 4).

Furthermore, Lecturer 1 was the only participant who articulated the codes produced from Turnitin report. She defined the colour codes as follows: first, the red code shows the high risk of similarities, drawing attention to students' work to be scrutinised closely. She would then call in the student to discuss the problem, indicating the process of (private) understanding. Lecturer 1 also indicated that Turnitin might flag red all the common words or numbers that cannot be changed: that does not mean the work is plagiarised. Second, the green code indicates that there is no need to be concerned; however, this depends how much green is flagged. Third, the brown code has its own connotations. Lecturer 1 also added that, if there is too much brown, there is the chance that it might change to red. Moreover, Lecturers 1 and 2 shared the same view that, if plagiarism has taken place, they call the student or students concerned. They discuss the matter with the student concerned, and read the plagiarism policy to them. After they had proved that a particular

student or a group of students have plagiarised, they would decide whether the assignment should be redone. If there a group of students' work is suspected to be plagiarised, only one paper is assessed. The mark given to that student is then divided among all those students who found plagiarised.

However, Lecturer 3 is the only participant who indicated that, before she talks about submissions of assignments to Turnitin, the lecturer first opens an account with Turnitin, indicating professional understanding. In addition, Lecturer 3 is aware that if one uses direct quotes, inverted commas should be in place, even though she does not use Turnitin. Lecturer 4 argued that Turnitin is not relevant in what she is teaching in mathematics, because students use their pencils to draw graphs and to prove the theorems. They do not type their work. Conversely, Lecturers 2 and 3 differ from Lecturers 1 and 4: when they mark they do share ideas on the same page, assisting students based on what they have agreed on. Lecturers 1 and 4 do not specify whether they communicate with other colleagues when doing the marking. Lecturers 2 and 3 are aware of professional, private, and public understanding of the procedures of assessing mathematics. Lecturers 1 and 4 showed professional and private understanding.

5.2.6 Theme 6: Role

What role do you play in assessment, utilising Turnitin in mathematics?

Role, in this context means the part which is played by a lecturer to assess students. Such would demonstrate the ability to assimilate theory and to practise utilising Turnitin in mathematics. The lecturers are expected to account for their role as an instructor, facilitator, and researcher. All four lecturers displayed their understanding as shown below:

Lecturer1:

> *"My role is to assess, mark and check students' understanding on the given material…are they able to critique the given material, assist students on apply their knowledge when they critique... I play an investigating role... Mine is to tell student submit on Turnitin but not in mathematics…. As lecturer I was not employed here as a SAP… I was employed as a teacher…the teacher teaches, but the university puts a blame on you and say you should have known...My role is to read student*

work, because students are at picking up lazy teachers... the university might also take further steps for lecturers who approved the work that is plagiarised… Another thing we teach teachers to teach… not to police them (Lecturer1)".

Findings from the comment above shows that the role played by Lecturer 1 is to teach the content of mathematics, assessing (instructor) and checking whether the students have in fact understood what they have been taught (researcher). She adds that she examines students' work, by reading students' theses, assignments, portfolios, and examination papers. She is not a detective. The lecturer complained that the university is not the one taking the responsibility for checking plagiarism. Lecturers, if they do not notice any form of plagiarism, are blamed for such oversight.

Lecturer 2:

"Is to set an exam, assignment, test, mark and critique the content written by student... I assist the students to be creative and use their own words if necessary... explain the danger of plagiarism that might end up expelling students from the university... To mark and check their understanding... Assist those students who are struggling to put their ideas into writing... Check students understanding of the material given to them, are they able to critique the given material. (Lecturer 2)".

With reference to the comment above the role of Lecturer 2 is to set examinations, set the questions or assignments, to assess (instructor), mark, and to assist students to write academically (facilitator). Lecturer 2 also comments that she assists students to improve their academic writing. However, she warns students about the rule of the university concerning plagiarism, by reading to them the rules and plagiarism policy (instructor).

Lecturer 3:

"I teach the methodology, e.g. how to teach. Critique a lesson, lesson plan, and materials…I read students writings, and mark once I can see that there is that

juncture… I give them feedback and request for sources... Then am able to judge whether there is wrong citation… is it a direct copied work without inverted commas... I give them tutorial task (group task), assessment inside the class which is marked there and then and lastly test and exams. (Lecturer 3)".

The comment in the above extract reflects that the role of Lecturer 3 is to teach students how to critique a lesson, to plan a lesson, and to source suitable materials for lessons. In return, she allows students to submit the critiqued lessons, lesson plans, and materials She further states that she assesses and evaluates students' work (instructor). If she suspects plagiarism, she asks students to submit the sources (researcher). She would be able to decide, based on evidence produced by the student, whether the problem is with citation, or whether there are missing inverted commas (facilitator). The participant adds that she assesses students through tutorial tasks, and group tasks.

Lecturer 4:

"My role is to set questions and memorandum, assess and mark students' work… if it is a practical work…I mark in the lecture room to see how they construct angles work, to assist them if necessary...Help a student to learn and improve (Lecturer 4)".

From the analysis of the excerpt above, Lecturer 4 sets questions and a memorandum or a rubric for mathematics. She further states that she assesses students through practical work (instructor). Lecturer 4 added that she marks students' work through interacting with them in order to see how they construct angles, or how they prove theorems, assisting, if necessary (facilitator).

Findings from the above excerpts indicate that all four lecturers play the role of the instructor; they assess and mark students' work, indicating professional understanding. However, Lecturer 1 complained that the university does not take the responsibility for checking plagiarism in students, lacking understanding of the role of a facilitator and a researcher. Lecturers 2, 3, and 4 are aware of the role of the facilitator in assisting students to improve their writing skills. Lecturers 2 and 3 demonstrated the role of a researcher when Lecturer 2 read the rules of the university concerning plagiarism, while Lecturer 3 requests sources from students if she suspects any form of plagiarism. Only Lecturer 2 displayed professional, private, and public understanding. Lecturer 1 demonstrated professional understanding only.

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5.2.7 Theme 7: Platform and Interval

In this context, platform is a place used by the lecturer when assessing mathematics, utilising Turnitin. An interval indicates the time spent by a lecturer when assessing mathematics, utilising Turnitin. The participants are expected to share their understanding, displaying inside, outside, and blended understanding in mathematics.

All four participants shared their understanding as follows:

Lecturer 1:

> *"I assess at my work place, I have my university account and the personal account that I use all by myself to assess at work place and at my place in order to meet the dead line… I send the assignments online via Moodle and assess immediately they send their work online. I don't wait for submission date… I mark students' work at any time as soon as they submit…since there are some students who are serious about their work…who do not wait for the due date…I also mark at day time (Lecturer1)".*

Findings from the comment above show that Lecturer 1 has to open an account for students before they are able to submit their work online, giving them access through her personal account. She also states that she assesses students' work online, as soon as students submit their work, either at the workplace or at home. In addition, Lecturer 1 marks students' work at the workplace during the day, according to her free time. She works until late at home to meet any deadlines.

Corroborating each other, Lecturers 1and 2 shared the same understanding.

Lecturer 2:

> *"…assess the work that I taught in lecture room and mark at my work place or at home, at time I stay at work place till mid night... Depending on the due date…I assess at my office, do the marking during the day if I don't have lectures…. stay overnight at work place and at my place at night or during the day over the weekend…I mark during the day at night and early in the morning…I mark online*

outside teaching time, at my office and at home as soon as they submit (Lecturer 2)".

Lecturer 2 assesses and marks students' work at her office until late if there is the pressure of a due date. She does the evaluation at home, working till late, or waking up early in the morning.

Lecturer 3:

"*… assess and mark students work at my office… at times I upload the student work via Moodle and mark at my place online…I assess and do marking anytime depending on the year plan… sometimes I wake up early in the morning at home or mark at campus till late or at day time…even during the weekends until late as long as there is work that is submitted. At time I give students tasks through google forms (Lecturer3)"*

Lecturer 3 marks students' work online at her office at work during the day, until late. She marks at home any time, even on weekends when there is work to be marked. There are also weekly tasks, meaning that Lecturer 3 marks weekly.

Lecturer 4:

"…I assess and mark at my work place or at home, at time I stay at work place till midnight…Depending to the due date of submitting…I sometimes mark students' work in the lecture room if it is a practical work to see how they construct...Help a student to learn and improve…I Mark during the day, either in my office when I don't have lectures… Sometimes I carry students' work to my place for marking…I do the marking till late (Lecturer 4)".

Lecturer 4 also assesses and marks students' work at the workplace. Lecturer 4 prefers to mark in the lecture room, so as to interact with students, assisting those who experience problems. She also

marks at home at any time as long as she does not have lectures. Lecturer 4 further indicates that she does mark manually, as she does not talk about marking online.

All four lecturers shared a similar understanding of the use of platform and time in assessing mathematics, even though they do not assess using Turnitin. They all used both the inside and outside environment of the workplace during the day, working till late or waking up early in the morning before the commencement of their daily work routine. However, Lecturer 4 is the only one who also marks students' work in the lecture room in order to interact with students during practical work. Lecturer 4 is aware of utilising both inside and outside environments, even if she is lacking online marking or assessment. Lecturers 1, 2, and 3 did not mention that they assess or mark inside the lecture room. Lecturer 4 has an understanding of professional, private, and public understanding; whereas Lecturers 1, 2, and 3 displayed the personal and public understanding only.

5.2.8 Theme 8: Resources

What resources do you utilise in assessing mathematics?

A resource is a tool used to assess utilising Turnitin in mathematics. The participants are expected to share their understanding of hardware, software, and ideological-ware. All four participants shared their understanding in terms of resources as applied in mathematics. This, they justified in the comments below.

Lecturer 1:

> *"... Student can go online and get the information and articulate it in a chart form... Students can turn into Microsoft and change PDF into word then change or edit the work... then it is easy to manipulate after that... Student can submit via software. Turnitin is one of the resource that would be like Moodle site...but I don't think that Turnitin is the best tool to check plagiarism, while I can do manual detection …In mathematics I do marking on my own... as a lecturer I have read so many theses…so I can be able to see that this thesis is so familiar because I have come across it…as I am involved in marking UNISA papers. I use my laptop to mark (Lecturer1)."*

Lecturer 1 uses a laptop in order to gain access to Moodle or Turnitin. To have access to Moodle she needs the Internet. Lecturer 1 does not believe that Turnitin is the best tool for checking plagiarism. She prefers to mark and check the work of students herself. She reads many theses of other students from UNISA, being able to pick up the copied work. Furthermore, students acquire the information online and communicate it in hard copy in chart form. Lecturer 1 revealed that students can manipulate the software by changing the PDF into Word, then editing the information.

Lecturer 2:

> *"…I use a laptop use Power point, laptop, I assess students myself…I use Moodle to access content to teach…assess students through Moodle, discuss with students at lecture rooms...they might also look up for something else like lesson plan and use real objects during their presentation. I also upload information, like assignments for student via Moodle so that they can learn while they are at computer rooms (Lecturer 2)".*

Lecturer 2 assesses students' work per laptop, using Moodle and giving feedback. She also uses Moodle to access information about the content to teach. Students have to visit Moodle to gain access to what is being taught, or what to learn, the learning material itself, and assignments to be done.

Lecturer 3:

> *"I use laptop to access google form which is found on Moodle… I use google form rather than Turnitin, where it checks and give feedback to students… I also use Moodle as a way of teaching and assessment…. There is other software (teaching tools) that you can use like GeoGebra and sketch pad… in google form one can load even diagrams (Lecturer 3)"*

Lecturer 3 uses Google Form instead of Turnitin. She said that she can load diagrams to Google Form. In addition, Google Form also checks and gives feedback to student. Furthermore, the

participant added that she uses Moodle to teach and evaluate. She also mentioned other software like GeoGebra and Sketch Pad that can be used in mathematics.

Lecturer 4:

> *"…use laptop of course… I use Google classroom as a form of teaching, overhead projector as way of teaching to teach, GeoGebra to show constructions of angles… student can use GeoGebra to construct angles… I use google form for teaching and learning…I assess and mark the work of student myself, I do not use Turnitin as a resource (Lecturer 4)".*

In agreement with the other lecturers, Lecturer 4 states that she uses a laptop, Google Classroom as well as Google Form for teaching and learning. She also states that she allows students to use GeoGebra to construct angles. She assesses and marks the work herself. She does not use Turnitin software to assess and mark students' work.

From the analysis of the excepts above, it is evident that all four lecturers share similar understanding on the use of resources. All lecturers use laptops (hardware) when assessing and marking students' work. In addition, they all apply their conscious mind (ideological-ware) to how to use the resources. However, there are various types of software resources to choose from, depending on which types they prefer, as listed in the various extracts above. For example, Lecturers 1, 2, and 3 commented that they use Moodle for teaching and learning; and GeoGebra to construct angles for teaching of mathematics, while Lecturer 4 talks about GeoGebra software, but she does not mention that she uses Moodle software. Lecturer 4 uses Google Classroom software as a teaching and learning tool.

All lecturers have an understanding of hardware when related to laptops and computers. They have understanding of software when they refer to Moodle, GeoGebra, Sketch Pad, Google Form and Google Classroom. They also show understanding of ideological-ware in using hardware and the software. All lecturers display professional, private, and public understanding in terms of utilising the resources. However, all the participants indicated that they do not utilise Turnitin in assessing mathematics, because of the culture of mathematics. For example, Lecturer 1 indicated that she

does not see Turnitin software as the best anti-plagiarism tool. She is able to detect whether the student has plagiarised, knowing this from reading other UNISA students' theses. This indicates professional, private, and public understanding. Lecturer 3 uses Google Form software to assess and mark students' work. Students also gain feedback through Google Form, indicating public and personal understanding. Lecturers 2 and 4 did not indicate how are they able to detect whether students have produced original work. They simply assess and mark on their own, indicating private understanding.

5.3 Summary

In this chapter, findings from the data generated were discussed with the intention of establishing lecturers' understanding of Turnitin utilisation. Moreover, this chapter intended to determine whether the case study conducted with the participants had had an impact on their practice. The findings were discussed through themes, attempting to answer the research questions in order to facilitate the development of the in-depth summary of lecturers' understanding of Turnitin utilisation in assessing mathematics. Findings discussed display that lecturers are aware of Turnitin utilisation. For example, lecturers share the same understanding of Turnitin utilisation in assessing mathematics. All lecturers interviewed have indicated that in mathematics it is impossible to detect plagiarism utilising Turnitin. In addition, lecturers indicated understanding of mathematics content by indicating that in mathematics there is common terminology, vocabulary, numbers, symbols, graphs, data handling, theorems and equations. As results it is difficult to detect plagiarism. However, lecturers lack understanding of integrating content with Turnitin in assessing mathematics. The next chapter extends this discussion and establishes how lecturers could overcome challenges, to successfully attain the prescribed goals. The next chapter also attempts to outline how findings addressed the research questions that directed this study.

CHAPTER 6: DISCUSSION ON FINDINGS, CONCLUSION AND IMPLICATIONS

6.1 Introduction

This study has striven to explore and understand lecturers' understanding of Turnitin utilisation and the implications on enactment. The previous chapter attempted to answer Research Questions 1 and 2, namely: What is lecturers' understanding of Turnitin utilisation in mathematics at a South African university? and How do lecturers understand utilisation of Turnitin in mathematics at a South African university? This chapter intends to answer the third research question, which is: Why do lecturers understand utilisation of Turnitin in mathematics in particular ways at a South African university? The aim is to develop educational performances and teaching styles (Halgamuge, 2017). The findings are discussed in line with themes that were guided by the concepts of the TPACK theoretical framework, which contributed to addressing the research questions of the study. This chapter focuses on discussing the findings through themes, with three propositions that form the phenomenon of this study. These are professional, private, and public understanding of Turnitin utilisation. The themes are rationale, resources, content, methods, assessment, role, location, and time.

The discussions of findings from the lecturers' data that were generated using reflective activity, semi-structured interviews, and document analysis are presented, analysed, and interpreted, in order to respond to Question Three of the study, namely: Why do lecturers understand utilisation of Turnitin in mathematics in particular ways at a South African university? The response was drawn from the findings, based on a guided analysis of the themes, namely, rationale, resources, content, methods, assessment, role, location, and time. Therefore, discussion of the findings covers understanding of four lecturers simultaneously, using the references from the literature reviewed in this study.

6.1.1. Rationale

As has previously been discussed, the rationale, according to this theme, indicates lecturers' understanding of Turnitin utilisation in assessing mathematics. The findings in this phase indicated that the common rationale of Turnitin utilisation is to catch students who use other people' ideas

and make them their own, indicating professional understanding. Even though their rationale indicated professional understanding, these lecturers prefer to use manual detection rather than Turnitin. Lecturers do not trust Turnitin, because, in some cases, it is not accurate. In addition, the findings indicated that Turnitin cannot critique GeoGebra. This is in accordance with Tyler's argument that Turnitin assists lecturers with the information Hiatt (1994), but they should not rely solely on it. In light of this argument, Batane (2010) confirms that it is not advisable to rely on Turnitin, because one cannot be sure whether this software is accurate in detecting plagiarism. Furthermore, lecturers find it easier to detect plagiarism manually, because they know their students. They are able to identify personal writing of their students, since Turnitin is not applicable to mathematics. The findings further revealed that, in mathematics education, students are required to apply their knowledge. There is little opportunity for students to plagiarise. However, there are studies disagreeing with the above statement. For example, Khoza (2018) argues that the problem with plagiarism is still a challenge. To fight this challenge, lecturers need to have a clear understanding of what constitutes the assessment, in order to determine the educational vision of utilising Turnitin. Turnitin software is a long-term tool which has been used for nearly ten years to help many universities and administrations fight the problem of plagiarism (Sutherland-Smith & Carr, 2005) . In other words, manual detection only is not enough. It is not plausible that lecturers can detect plagiarism without Turnitin utilisation. Moreover, the results demonstrate that it depends on lecturers' decision to determine whether the students have plagiarised or not. Therefore, in determining their educational rationale, lecturers have to understand and construct their own unique identity, which might help them to choose whether to take professional, private, or public understanding, or to integrate their understanding of Turnitin utilisation during their assessment (Rolfe, 2011).

On the other hand, the rationale of the University of KwaZulu Natal's (UKZN) plagiarism policy and procedures indicates that it does not tolerate plagiarism within the institution, applying appropriate prevention and detection controls. The detection controls include the external examiners, plagiarism-identification software, and other checking mechanisms, as prescribed in the system. However, the policy is not specific about Turnitin utilisation in mathematics; but the university does provide the (TII) training programmes. These training programmes need to address

utilisation of Turnitin in mathematics. This policy should be reviewed in order to bridge the gap between professional, public, and societal understanding.

6.1.2 Goals

In this study, goals were classified into aims, objectives, and outcomes. In this phase, lecturers reflected on aims (private), objectives (professional), and learning outcomes (public) of Turnitin utilisation. Even though their responses were not specific, they showed knowledge of aims, objectives, and learning outcomes. The findings indicated that lecturers are aware that the aim of Turnitin is to detect plagiarism, indicating public understanding. In addition, the results revealed that Turnitin intends to discourage plagiarism, promoting honesty and independence to students (private understanding). Moreover, the findings revealed that students can manipulate Turnitin, which is one of the reasons they are not exposed to it, indicating personal understanding. Turnitin teaches staff members, students, and the community to produce their own work of which they can be proud. Through Turnitin, students' academic writing is developed, paving the way for in-depth learning. The findings concluded by indicating that the lecturers' understanding of Turnitin utilisation in mathematics is that all the submitted work is flagged as plagiarised, because of the symbols and formulae common to answers.

However, the University of KwaZulu-Natal plagiarism policy employs a development approach to detect and prevent plagiarism (personal understanding). It also reinforces existing systems, policies, procedures, rules and regulations of UKZN aimed at detecting, reacting to, and reducing the occurrence of plagiarism (Vithal, 2009). This policy specifies the personal and professional understanding. It is silent about the utilisation of Turnitin in terms of detecting and sharing information.

6.1.3 Content and activities

This study was in line with that of Berkvens et al. (2014), who are for the idea that the basic components of content and activities should consist of three levels of understanding. Such understandings are essential to a student in order to find his or her identity, as a suitable learner (professional understanding), a trained skilled employee (private), and an active supporter of the community (public understanding). The findings of this research indicated that lecturers lack the

knowledge of three levels of understanding. Their understanding on content was based on personal understanding; and their focus on assessment was dominated by students' knowledge (personal understanding). These lecturers indicated that they give activities that demand students' knowledge to critique the content. In addition, lecturers reflected on the challenge of utilising Turnitin in mathematics. Most often they commented about the challenge of Turnitin utilisation in assessing numbers, symbols, common answers, and equations, proving theorems, construction of angles, language and terminology, as well as equations. Moreover, the findings suggested that Turnitin software should include translation features. This resulted in lecturers' personal understanding of Turnitin utilisation, driven by manual detection, excluding professional and public understanding. Schubotz et al. (2019), partially agree with the findings, indicating that Turnitin should be utilised in conjunction with the traditional text-based detection, but not that lecturers should not utilise Turnitin.

On the other hand, studies conducted on mathematics utilising Turnitin disagree with the findings. These studies indicate that Turnitin has the following options during marking: set the number of words that are compared for matches, exclude bibliographic materials from similarity checking, exclude materials with quotation marks, create comments stamps for comments they make on a particular assignment, creation of solution set that includes correct solution, create a code sheet for common mistakes and creation of a grading rubric (Crannell, 2014; Razon et al., 2017; Schubotz et al., 2019). Furthermore, Oghigian et al. (2016) add that utilising Turnitin in assessing mathematics is possible, indicating that Turnitin has a system. Lecturers might need to adjust the percentage from the common vocabulary language, tables, formulae, and equations within mathematical context which cannot be changed. In addition, only one lecturer was aware of the colour codes generated by Turnitin. The findings indicated that lecturers can use their understanding of mathematics content to adjust the percentage, as well as ignoring the common content that cannot be changed, flagged by Turnitin. The findings indicate that the lecturers' lack of content knowledge results in lecturers struggling to select and sequence content appropriately, to ensure conceptual development within Turnitin utilisation in mathematics (Hoadley & Jansen, 2012). Therefore, professional development is needed for such lecturers to be empowered with a vision. Aims and objectives might help decisions to be made on the content as well as to focus on skills important for students to acquire in terms of technology (Berkvens et al., 2014). As a result,

there is no apparent alignment between professional, private, and public understanding. On the other hand, the UKZN plagiarism policy does not specify the content and activities of Turnitin utilisation in mathematics. Instead, the policy stipulates that the university ensures that all staff take the opportunity for education and training in plagiarism, familiarising themselves with it, and complying with the plagiarism policy and procedures (Vithal, 2009). The training workshop conducted by Chetty (2014) is evidence that the university conducts Turnitin training programmes. The TII training programme discusses the options setting, that excludes small matches, exclusion of bibliography, choosing between word count and percentage, and choosing whether to submit paper to original, stationary, or warehouse, but not specifying the content and activities in mathematics. The UKZN plagiarism policy and workshops conducted within the university need to be reviewed in order to accommodate the content of mathematics for Turnitin utilisation.

6.1.4 Assessment

Findings from this stage underlined the importance of assessment as one of the key concepts of evaluation experience, as well as Turnitin utilisation as part of assessment in the education curriculum (McCracken et al., 2011). The findings indicated that lecturers are familiar with types of assessment, even though they did not use the relevant terms. In addition, they reflected that they use formative, summative and peer assessment. The findings declared that lecturers use assignments, portfolios, tests, presentation, tutorial examinations, critique lessons, lesson plans, and materials. This indicates that students are given an opportunity to apply their knowledge as well as to gain feedback about their learning process. Furthermore, lecturers demonstrated their awareness of tracking the progress of students. Diverging from the formative assessment, students are assessed after the completion of the module through manual detection. Moreover, students are also given the opportunity of learning from and reflecting on their own presentation of self-assessment. The challenge that the lecturers are experiencing is lack of assessment through Turnitin utilisation. These findings indicated that manual detection is another procedure for assessment in mathematics. The University of KwaZulu-Natal's plagiarism policy stipulates that lecturers are obliged to familiarise themselves with the existing software identified for them; and to motivate their students to utilise it to check whether the work to be submitted is their original work, before the submission is made (Vithal, 2009). Furthermore, lecturers are required to be alert to and to write down any instances of plagiarism when examining any work. The staff has to be

sure that the accusations made are embedded in proven, well-documented evidence. Staff must follow the correct procedure of the policy, if plagiarism is suspected, and not take any unilateral punitive action against any student, first following procedure (Vithal, 2009). However, the university conducts Turnitin training programmes for the staff within the university. The training takes the staff through the whole process of Turnitin utilisation in terms of assessment, even though it is not specific about the subject, as in that conducted by Chetty (2014).

6.1.5 Procedures

This concept combines different methods of assessment. The reason for this is that students are unique, and they understand differently. The findings highlighted that lecturers mark and assess the work of students personally, using the rubric or memorandum. Additionally, the findings indicated that students are assessed on assignments, portfolios, tests, presentation, tutorial tasks, flowchart, examinations, critique lessons, lesson plans, and materials. It is also evident that lecturers demonstrated careful reading of the work of students in marking and assessment, indicating the product process. In addition, it is evident that students' work is assessed and scrutinised by lecturers. Moreover, the findings indicated that, if plagiarism is suspected, students are called in to find the reason behind possible plagiarism. Furthermore, it is displayed that the rules and the procedures are read to students who are suspects to remind or warn them. Lecturers use the procedure method, meaning that they detect and educate students on the importance of writing their original work. Lecturers also read university plagiarism policy and warn students about the consequences of plagiarism; indicating product as well as process procedures, professional, and private understanding.

The findings also indicated that lecturers do detect to educate, as indicated. If there is a need, they assist students to avoid plagiarism, indicating process procedure (private understanding). Lecturers displayed team work, in which they share student papers for marking. They share student work, indicating interactive procedure (public understanding). However, only one lecturer demonstrated understanding of colour codes produced from a Turnitin report. Colour coding proved challenging for all lecturers, because, even though one of them was aware of the colour coding, she does not utilise Turnitin in mathematics. This indicates that there is no balance between the goals to be achieved in terms of Turnitin utilisation.

However, the University of KwaZulu-Natal's plagiarism policy indicates that, to prevent plagiarism, lecturers should have knowledge as well as understanding of what constitutes plagiarism. The policy also specifies that lecturers should provide students with all the necessary information concerning plagiarism, the use of sources, and referencing, providing structured feedback. Furthermore, students should sign a declaration which includes all required information concerning work submitted, ensuring that there are no instances of plagiarism. In addition, the university provides lecturers as well as students with TII training programmes on the procedures of utilising Turnitin, as with that conducted by Chetty (2014). Conversely, the plagiarism policy does not specify whether Turnitin should be utilised in mathematics. The policy lacks technological pedagogical knowledge.

6.1.6 Role

This concept is significant, indicating role play by individual lecturers according to own understanding and the way the individual interprets the intended curriculum. Lecturers were allowed to reflect on their understanding in order to have a clear picture of the reality of their teaching practice. The lecturers were expected to share their understanding on three roles, for example, instructor, facilitator, and researcher, on Turnitin utilisation. The findings showed that lecturers set questions, rubrics, and memoranda, as well as assessing and marking students' work. The findings indicated that lecturers investigated students' work (instructor). Lecturers read and examined students' assignments, portfolios, tests, examinations, and practical work. It appeared that lecturers play the role of detective (instructor), complaining that the university is doing little to investigate. The findings further indicated that lecturers are supposed to teach students to become good teachers (facilitators). It is also evident that lecturers facilitate the assessment process if there are students who are facing challenges. Furthermore, lecturers assist students to be able to write academically. In addition, lecturers indicated that they read rules and procedures of the plagiarism policy (instructor). Moreover, it is evident that lecturers give students opportunities to critique lesson plans, accessing lessons and teaching material. In addition, it was revealed that, if plagiarism is suspected, sources are required in order to find where the problem lies. Lecturers speak to students who plagiarise. If there is the need to rewrite, they do so (public understanding). The findings further revealed that the plagiarism that usually occurs is minor; it does not need to

be reported. This may be caused by inappropriate citation, or by forgetting to use inverted commas, when quoting direct speech. The findings further revealed that students are given a chance to interact with their lecturers, indicating researchers' role. However, the findings indicated that one of the lecturers uses Google Form instead of Turnitin. In the findings, it was revealed that the rubric is designed through Google Form; students gaining feedback through Google Form. The University of KwaZulu-Natal plagiarism policy specifies that all staff members have the responsibility of detecting, reacting, preventing and reporting allegations of plagiarism to their line managers, a senior manager, or through available mechanisms like the whistle-blowing policy. The policy further states that alleged plagiarism by any member of staff will be investigated with a view to disciplinary action. The policy is silent about the role of a lecturer for Turnitin utilisation in mathematics.

6.1.7 Platform and interval

Assessment is supposed to take place in a conducive platform at the right time for the benefit of both lecturer and student. Individual lecturers choose a suitable place and time for assessing and marking, as long as the due date is met. Lecturers have to design their own time and the environment that is conducive for them. Findings showed that, in most cases, lecturers assess and mark both at their workplace and outside the workplace at any time. Lecturers are flexible; they have access to an online environment which makes it possible for them to assess and mark at any time, be it morning or night time. Assessment is tailored around meeting certain aims and objectives (Berkvens et al., 2014). Moreover, the findings displayed that lecturer have a vision of their profession in the interests of a student, working under pressure to achieve the university goals. Findings also show that lecturers are aware of blending assessment; at times, they mark and assess in lecture rooms as well as online. They are also aware of face-to-face and online assessment. However, none of the lecturers utilise Turnitin software for assessment in mathematics. The university of KwaZulu-Natal plagiarism policy is silent on platform and time for assessment in mathematics. Lecturers must use their discretion for platform and time in assessing mathematics.

6.1.8 Resources

This concept allows lecturers to use their ability to carry out assessment through the use of a resource (Khoza, 2013a). The findings indicated that lecturers are aware of the three categories

even though they did not use the proper terms for the resources. Lecturers demonstrated that they use the laptop (hardware) when they want to upload learning material through Moodle, Google Form or Google Classroom (software) for students to learn; and to accommodate students who did not attend lectures for different reason (ideological-ware). Lecturers use various resources to benefit teaching and learning. Lecturers demonstrated professional, personal, and public understanding. Lecturers were expected to reflect on the resources they turned to for Turnitin utilisation in mathematics. Instead, they used human resources with traditional detection. Furthermore, it was revealed that one of the lecturers uses Google Form instead of Turnitin for assessment in other modules with postgraduate students. This lecturer uses her personal understanding in choosing Google Form, the policy not being specific on the software to be used by the university staff on assessment. However, there is a challenge faced by mathematics lecturers, as they do not utilise Turnitin for assessment in mathematics. It must be asked whether mathematics lecturers do attend Turnitin training. Policy specifies that the university ensures that all staff members attend Turnitin training. It is also evident that such training is conducted as demonstrated by Chetty (2014). This implies that the lecturers do not use the resources accordingly to fulfil the purpose of assessment utilising Turnitin in mathematics to achieve the outcomes.

6.2. Conclusion and Educational Implications

The results of this study suggest integrating technological content detection knowledge (TCDKM) and manual content detection knowledge into mathematics education (MCDKM). The theoretical framework indicates that the content, pedagogy and technology guide teachers' understanding of technology integration in teaching and learning (Mogari, 2014; Niess, 2005, 2007). In mathematics there are situations in which Turnitin utilisation for preventing plagiarism is inadequate to achieve the required goals, because of the culture of mathematics. For lecturers to achieve the aims and objectives of preventing plagiarism in the content of mathematics, there is a need to utilise a manual-detection approach, which indicates personal understanding. This implies that TPACK in mathematics might not be the same as TPACK in other subjects (Mudzimiri, 2012). In terms of TPACK, there are areas where it does not work well because of the content that is used. For example, content in mathematics consists of numbers, symbols, graphs, equations, formulae, tables, theorems, images, as well as esoteric terminology (Corbin & Bugden, 2018; Muhammad, 2016; Rogerson & McCarthy, 2017). This statement is supported by the findings for instance L1

“In mathematics there is a challenge of using Turnitin, like numbers, symbols, graphs, and some language and terminology cannot be translated”. This shows that application of Turnitin in mathematics content may result in all students’ work being flagged as plagiarised.

In mathematics, numbers have the same value, globally. If students have to solve this equation − 2(4x-y) +3 (-2y- 4), having the knowledge of solving a given equation, the answers will be the same. In general, if students upload such work to Turnitin, these submissions will be flagged as plagiarised. Lecturers should then show understanding of technology by looking in depth at reports flagged by Turnitin. Lecturers must be able to understand the content that indicates similarity, such as mathematical equations, tables, and formulae (Pamuk, 2012). This implies that technological content knowledge helps lecturers to understand how technology can be used with mathematics to make the teaching process more effective. However, there are times in which TCK and content limit one another (Kafyulilo, 2010). It becomes problematic if lecturers do not have an understanding of how to bring technology into content, as revealed in the findings of this study. To overcome this challenge, there should be other methods of integrating TCK, such as manual detection.

Generally, there are two ways in Turnitin utilisation for assessing mathematics content, as revealed in the findings of this study. This is technology detection (TD) and manual detection (MD). TD is the ability to utilise technology to detect similarities in mathematics. MD is the ability to use the conscious mind to assess and check plagiarism in mathematics. TD and MD require lecturers’ understanding of content knowledge (CK) in mathematics. Technology detection (TD) requires lecturers’ understanding of technology and content knowledge in mathematics. This indicates the integration of TD and CK, which result in technological detection content knowledge in mathematics (TDCKM). This knowledge cannot detect plagiarism because of the commonalities of numbers, symbols, terminologies, equations and graphs assessed in mathematics, but it identifies and highlights strings of text that match that of other sources (Mphahlele & McKanna, 2019). TDCKM can assist lecturers to detect a pile of student papers in a short period, as revealed in the findings of the study, indicating professional understanding. In other words, Turnitin utilisation can assist lecturers to assess the correctness of the content, symbolic notation, tables, numbers, theorems, or graphs (Craig, 2007), in mathematics.

This implication is that, if Turnitin flags the mathematics content submitted, the work is incorrect. If Turnitin does not flag the mathematics content submitted, this means that the content is correct. In this respect, TDCKM works well in conjunction with manual detection (Schubotz et al., 2019). On the other hand, MD requires lecturers' understanding of content knowledge in mathematics (MDCKM), which might vary according to lecturers' personal understanding. MDCKM assists lecturers to check and assess students' work. Assessment of content in mathematics requires an integration of TDCKM as well as MDCKM to be effective and sustainable. This simultaneous integration knowledge of technology, manual, detection, content in mathematics produces the TMDCKM theory.

In addition, the findings indicate that lecturers allow students to critique lesson plan, observing the lessons and making presentations. All these assessments involve numbers, symbols, and equations, which make it difficult for lecturers to use technology. This is an indication that technological content knowledge does not work well in assessing the content in mathematics. Lecturers lack understanding of technologies, which leads to a manual approach for assessment, which is MDCKM indicating private understanding. This approach demands that lecturers have an understanding of their pedagogy to be able to interpret the difference between appropriateness and dishonesty, to fairly judge students' work (Garba, 2017). The findings indicate that lecturers prefer to use MDCKM as the significant approach in the assessment context. This helped lecturers to understand their individuality in terms of assessment (Khoza, 2016). The lecturers were able to play a facilitating and an investigative role in assessing student's work, since the application of technology was unable to detect effectively submitted content in mathematics. It might be helpful to lecturers when used in document review to examine the strings detected by Turnitin (Oghigian et al., 2016). The document review requires lecturers' usage of assets like hardware, software, as well as ideological-ware. The findings indicated lecturers' lack of understanding on the usage of Turnitin software in mathematics.

The results indicated that application of private understanding, using their ideological-ware resources, dominated the process of Turnitin utilisation. The lecturers used their higher thinking skills to promote the usage of hardware resources such as computers and software resources like

GeoGebra, Moodle, Google Classroom as well as Google Form to assess students' work (Khoza, 2017; Supardi et al., 2015), as revealed in this study, indicating private understanding. Through these technological resources lecturers were able to mark students' work and evaluate accordingly (Siddique, 2017). These resources, were used in online, or face-to-face environments in which lecturers were able to interact with students, discussing the commonalities of academic writing, as well as addressing the needs of education (Augusto et al., 2010 ; Chew et al., 2015; Liu & Taylor, 2014). Findings indicated that the face-to-face environment was used by day, which allows lecturers to discuss the identified commonalities or concerns about individual students; and enables appropriate interventions to be made with more focused feedback (Obara et al., 2018). The outside platform dominated the assessment process, which encouraged the utilisation of technology at any time of the day and night, indicating private understanding. However, the online space was also recommended, in case students missed lectures, or had an assignment to do in their own time. Nevertheless, in this study, the findings revealed the lack of lecturers' understanding of integration of TCK with content knowledge of Turnitin utilisation in mathematics.

6.3 Addressing the Research Questions

From the onset, this study has been conducted to respond to the three main questions premised on the research. The study explored lecturers' understanding, with the intention of responding to the research questions of *what* and *how* they understand Turnitin utilisation, as well as *why* they understand it in a particular way. The study is based on existing literature, the UKZN plagiarism policy document, and data generated guided by the concepts of TPACK. Furthermore, the case study was conducted to further attempt to respond to these questions with the use of reflective activity, semi-structured interviews, and document analysis. These research questions are addressed separately.

6.3.1 Question 1: What is lecturers' understanding of Turnitin utilisation at a South African university?

The literature suggests that lecturers' understanding of Turnitin may not be identical (William & Jun, 2006). According to Khoza (2015b), lecturers' understanding is dominated by disciplinary/professional, personal, and societal understanding. Professional understanding drives lecturers to focus on scientific knowledge which is specific to Turnitin utilisation (Hoadley & Jansen, 2013). In Turnitin utilisation for scientific understanding, lecturers detect and punish.

These lecturers place the subject matter as the main concept that determines what is to be assessed in the teaching and learning contexts (van den Akker et al., 2009). In assessment contexts, lecturers are required to focus on the report generated by Turnitin. This implies that lecturers are needed to scrutinise the quotations, content, citations, and paraphrasing generated by Turnitin (Ayon, 2017). According to the above literature, Turnitin guides lecturers to professionally pay attention to the text flagged by Turnitin.

Personal understanding of Turnitin utilisation places the individual's needs and interests at the forefront in the teaching and learning environment (Khoza, 2016). If personal understanding dominates lecturers' understanding, this means that lecturers utilise Turnitin to detect and educate (Khoza, 2015b). Lecturers interpret the Turnitin report randomly, according to their own understanding, assisting students accordingly. In the same vein, lecturers use their understanding for developing students' knowledge, skills, and values through a Turnitin report. Similarly, lecturers decide, after carefully checking the Turnitin report, to cater for individual student's understanding and needs (Hoadley & Jansen, 2012). According to Henderson et al. (2011), to cater for students' needs, lecturers need to understand their own practice, and their conceptions of assessment that influence it, before being able fully to embrace the utilisation of Turnitin. In this respect, lecturers would be in a position to recognise their identity to accommodate diversity. However, according to the literature, public understanding places societal issues and needs at the centre of the teaching and assessment environment (Schiro, 2013; van den Akker et al., 2009). If lecturers are driven by public understanding, the usage of Turnitin is centred on peoples' opinions. Lecturers must be careful of other people's opinions, because such individuals are influenced by general knowledge (Chew et al., 2015), and they might give wrong opinions because they seek attention.

Overcoming the challenge of general knowledge, the TPACK framework is used to serve as a structure in support of the rationale for this study, to answer the research questions (Grant & Osanloo, 2014). The above literature indicates that TPACK serves as a suitable framework that bridges teacher education and educational technology (Tzu-Chiang et al., 2013). This framework is about understanding cognitive, social, and developmental theories of teaching and learning (Öndeş & Çiltaş, 2018). The application of these theories supports the knowledge based on the

phenomenon to be examined (Budden, 2017). This knowledge assists lecturers to have a clear understanding about the benefit of teaching when integrating Turnitin into mathematics education (Alrwaished et al., 2017; Durdu & Dag, 2017). Knowledge is necessary for the design of the curriculum and instruction focused on preparation of lecturers' reasoning for teaching mathematics with digital technology (Niess et al., 2009). Similarly, teaching in higher education relies on the application of TPACK, which has an influence on educational framework through the incorporation of technological knowledge and technological, pedagogical, as well as content knowledge (TPACK) (Jwaid, 2016). In this case, lecturers displayed the knowledge of integrating TPACK in their field.

Using the case study, lecturers were able to reveal their involvement through reflective activity, individual semi-structured interviews, as well as document analysis that are vital elements in the development of TPACK. The lecturers were able to reflect on what they understand about Turnitin utilisation. Lecturers' understanding reflects professional understanding on other subjects, but, in practice, lecturers' understanding for Turnitin utilisation in mathematics was based on their own understanding as well as memoranda, since mathematics deals with common numbers, symbols, terminology, equations, theorems and tables and students also apply their knowledge. Their identity is supported by the policy which gives them choice. The policy is not specific on what to understand, or the approach to be used in detecting plagiarism. Therefore, in determining educational rationale, lecturers need to understand and construct their own unique identity. Such might help them to choose whether to employ professional, private or public understanding, or to integrate their understanding of Turnitin utilisation during their assessment (Rolfe, 2011).

6.3.2 Question 2: How do lecturers understand utilisation of Turnitin in a particular manner at a South African university?

This questions address how lecturers understand utilisation of Turnitin the way they do, following the TPACK themes as well as UKZN policy through a case study. The case study assisted lecturers to reflect and interpret on their understanding; and to share how they feel about the reality in their teaching practice**.** The identified themes were contributory in addressing the above question. These themes were helpful in providing the guidelines that clarified this question. The themes are goals, content and activities, assessment, resources, procedures, lecturers' role, platform, and time.

In line with the goals of UKZN plagiarism policy, it stipulates that the policy intends is to address and provide the aims and objectives. The aims and objectives of this policy are to prevent, educate, detect, and react on plagiarism based on evidence. In this respect lecturers have an understanding of the goals of utilising Turnitin in assessing mathematics. The lecturers indicated that they mark and check students' work personally, they also use their own knowledge to detect plagiarism, indicating aims and objectives. This method of detecting might be a challenge because not all students are honest. Some students might take a chance and copy other students' work, this becomes impossible for lecturers to detect student work using their experience or their own understanding. As lecturers revealed that there are times when they do not trust students with the assignments they submit.

However, the findings aligned with Khoza (2013b)'s statement that objectives are formed according to facilitators' objectives rather than students' needs. Students are not given the chance of understanding Turnitin utilisation, since they are not exposed to Turnitin. Such students might lack the knowledge and skills of technology that might prepare them for the future. In that case, the outcomes were not achieved, since students are not involved in detecting plagiarism in mathematics utilising Turnitin. This might indicate a lack of technological knowledge on the part of lecturers (Özgün-Koca et al., 2010). Moreover, lecturers did not indicate whether they do read plagiarism policies and procedures for investigation of suspected plagiarism in examined assignments, with an aim of preventing and reducing plagiarism (Vithal, 2009). This indicate that students might get away with plagiarism, if there is no proof that the policy rules were read for them.

Moving forward, Content in mathematics involves symbols, formulae, graphs, and equations which need Turnitin to be modified (Mphahlele & McKanna, 2019). The UKZN plagiarism policy is silent about the assessment of content in mathematics utilising Turnitin. Mathematics is full of standard formulas, operations, numbers, calculations, symbols, common solutions, equations, and theorems (Confrey et al., 2010; Ersoy & Güner, 2015; Gravemeijera et al., 2016; Khoza & Biyela, 2019; Lithner, 2017; Vale, 2013). The findings concur with the above mentioned authors indicating that the content involve common numbers, symbols, language that cannot be transferred, terminology, graphs, theorems, Data handling. Lecturers indicated that they assess students through content and activities that involve the above mentioned commonalities. One of the

lecturers made an example by saying how can one utilising Turnitin on activity that require student to prove a theorem such as: an angle of tangent between the cord is equals to the angle with alternate circle, show all the calculations. This lecturer continued that students in mathematics are encouraged to use GeoGebra, in that case, the solution come out the same. Requesting students to uploading their activities to like that to Turnitin, the report will indicate that all students have plagiarised. The findings indicated that there is a gap between Turnitin and the content of mathematics. There should be a link between the technology used in the delivery of a specific subject, for instance, mathematics, and the technological content knowledge (Mudzimiri, 2012). Findings showed that, instead of utilising Turnitin to detect plagiarism, lecturers applied manual detection in mathematics for assessment (private understanding), indicating a lack of technological knowledge.

Assessment is categorised into formative, summative, and peer assessment. The lecturers indicated that they assess students on assignments, portfolios, tests, presentation, tutorial examinations, critiqued lessons, lesson plans, and materials. Lecturers indicated that they engage these activities through the above-mentioned categories. In summative assessment activities involved are tests and examinations. In formative assessment, students are engaged in assignments, portfolios, critiquing of lesson plans, presenting lessons and conducting observation. Peer assessment involves student presentation. In all the above mentioned activities lecturers indicated that they assess students work through manual detection. In the above-mentioned activities, lecturers experience the challenge in the application of their knowledge when utilising Turnitin software for assessing the content. Kafyulilo (2010) asserts that, even though the integration of TPACK is receiving great emphasis in the educational world, there is no proof that teachers are appropriately integrating technology, pedagogy, and content concepts in their teaching and learning. This study confirms that mathematics lecturers do assess through manual detection only. This indicates that mathematics lecturers need to be aware that, now Turnitin offers an assessment platform, plagiarism-detection technology should be understood in conjunction with assessment, as they are now integrated (Canzonetta & Kannan, 2016). However, the findings indicted that there are two methods of assessment and detecting plagiarism. These methods are technology detection (TD) (professional understanding) and manual detection (MD) (private understanding) in mathematics. There is no single strategy of assessment in mathematics. Therefore, lecturers use their understanding in

assessing mathematics for educational purposes (Alrwaished et al., 2017; Koehler & Mishra, 2009).

In assessing mathematics content, lecturers should have knowledge of integrating hardware, ideology, and software resources. There are three types of resources in assessing mathematics. These resources are hardware, software and Ideological ware. The findings indicated that lecturers utilise different resources. Lecturers indicated that they use Google Form, Google Classroom and Moodle (software), for teaching mathematics through laptops (hardware), but not for assessment in mathematics. These resources are used so that students may have access of what was taught (Ideological-ware), have access of the assignment they are required to do and have access to the program of the year. The results indicated that ideological-ware dominated assessments in mathematics. Lecturers were driven by their conscious minds to utilise a traditional method for detecting plagiarism and assessing in mathematics, since the content of mathematics is common, globally. Lecturers have the knowledge of integrating hardware, ideological-ware, as well as software. The only challenge is that lecturers lack Turnitin utilisation in assessing mathematic. Lecturers are not deviating from the policy because it does not specify that lecturers should Turnitin to prevent plagiarism. The policy indicates that lecturers may apply other mechanisms for checking plagiarism (Vithal, 2009). The policy However, that does not mean that Turnitin cannot be utilised in mathematics. Turnitin can indeed be utilised for online marking of students' submissions, evaluating them accordingly (Siddique, 2017).

Furthermore, in the findings, it was displayed that lecturers' roles were balanced; it was evident that lecturers displayed the role of instructors, facilitators, and researchers. Lecturers were aware that they had to examine students' assignments, portfolios, as well as practical work through marking using detecting method indicating instructor's role. it was evident that, if lecturers suspected students of plagiarising, they are required to give evidence by submitting sources or giving an explanation to allay suspicions. Failing which a suspected student (s) is being called and warned and the rules of plagiarism policy are read. The student work approved of being plagiarised is given a chance to redo the work. If the suspected work is found plagiarised among students, that means only one paper is marked, that mark is shared among all those students who are found copied, indicating a facilitator's role. Moreover, lecturers allow students to do investigative role

by allowing students to critique lessons plans, lessons as well as teaching materials displaying a researcher's role. This indicates that lecturers are using the productive procedure by giving students tests and examination, following the policy by assessing students' work, including appropriate penalties that might occur in each paper (Hoadley & Jansen, 2013). The process procedure is indicated when lecturers demonstrate a facilitating role educating them about plagiarism, read plagiarism policy and allow students to redo the work in order to submit their own work. As Anney and Mosha (2015) declare that in the process procedure, lecturers detect to address the problem through introduction of academic writing skills. The interactive and critical procedure is displayed when the students critique the lesson plan, teaching materials as well doing the presentation in the lecture room during day time, evaluating one another. This process is supported by Naka and Nagoya (2015), indicating that student may provide feedback for one another. The only thing that was missing was the utilisation of Turnitin in mathematics, which was lacking through the entire assessment. This gap needs a thorough inspection on the side of the university to address this problem. As one of the participants indicated that she had no idea of how Turnitin works. It might happen that lecturers lack skills and knowledge of utilising Turnitin, or some lecturers do not attend trainings pertaining Turnitin organised by the university.

6.3.3 Question 3: Why do lecturers understand utilisation of Turnitin in a particular manner at a South African university?

This question three is the final question of the questions that guided the analysis of the findings. The question is: Why do lecturers understand utilisation of Turnitin in assessing mathematics in particular ways at a South African university? The findings were obtained by summarising the results found from question 1 and 2 guided by the themes of TPACK as well as UKZN plagiarism policy. The identified themes that were used in addressing question 3 are: The themes are rationale, goals, content and activities, assessment, procedures, lecturers' role, platform, and time.

The plagiarism policy document indicates that the purpose of this university policy is to lay down the terms and conditions of the university of KwaZulu-Natal to plagiarism. The policy also specifies that intention of plagiarism policy is to enforce the existing systems, policies, procedures, rules and regulations of UKZN aimed at deterring, preventing, detecting, reacting to, and reducing the impact of plagiarism (Vithal, 2009). In support of this policy, Chew et al. (2015), declare that

the quality assurance agency (QAA) has forced universities and higher education institutions to have effective measures set in place that deal with breaches in assessment regulations; most commonly dealing with offences relating to plagiarism, such as Turnitin. In addition, the staff from other universities are aware of Turnitin (Thompsett & Ahluwalia, 2015). The UKZN policy document also stipulates that, the policy applies to all staff and students of UKZN.

The findings indicated that, lecturers do understand that utilisation of Turnitin in assessing mathematics is to catch students who use other people' ideas and making their own. The challenge is that all lecturers do not utilise Turnitin. Lecturers indicated that they could not see the benefit of using Turnitin because in most cases students are required to apply their knowledge. The findings also indicated that lecturers they do apply plagiarism policy rules as they indicated detect students work on their own and that they do not trust Turnitin, that is why they prefer to use the traditional method of assessment. Lecturers indicated that they do work towards the aims and objectives as indicated in 6.3.2, what is lacking is the achievement of the outcomes since students are not exposed to utilise Turnitin to check the similarity from their work. Learning outcomes focus on what students should achieved and what they can demonstrate at the end of teaching and learning (Kennedy et al., 2006). Students' right who are doing mathematics with such lecturers are infringed since they are not given a chance of understanding Turnitin utilisation. Such students might be jeopardized, lacking knowledge and skills of technology that might prepare them for the future. In that case, the outcomes were not achieved, since students are not involved in detecting plagiarism in mathematics utilising Turnitin.

In terms of content lecturers indicated that culture of mathematics does not allow them to utilise Turnitin, so they do not utilise Turnitin in assessing mathematics. The findings revealed that mathematics has a lot in common as indicated in 6.3.2 that, mathematics consists of common numbers, symbols, equations, calculations tables, graphs, theorems, formulae, mathematical language, and vocabulary throughout the world (Corbin & Bugden, 2018; Pamuk, 2012). Lecturers reveal that, the content and activities are presented through portfolios, assignments, critique lesson plan and observed lessons and presentations as indicated on question 6.3.2. These activities were used for formal assessment and peer assessment. For summative assessment lecturers use tests and examinations. Lecturers indicated the above mentioned content and activities as well as

assessment, do not allow them to utilise deal with Turnitin, since they deal with numbers, symbols and also the work that demand students 'knowledge as the critique observed lessons as well as presented lessons as indicated in 6.3.1 and in 6.3.2. This indicate lecturers have the limited of TCK and content (Kafyulilo, 2010), which becomes problematic if lecturers do not have an understanding of how to bring technology into content.

These findings indicate that mathematics lecturers do not attend the Turnitin training programs provided within university, like the Turnitin training workshop conducted by Chetty (2014). In training workshops lecturers are developed on how to mark and detect mathematics utilising Turnitin. The university staff is trained on how to use different options from Turnitin. For example, there are options to (1) set the number of words that are compared for matches; (2) exclude bibliographic materials from similarity checking; and (3) exclude materials within quotation marks (Razon et al., 2017). This indicates mathematics have to attend Turnitin training workshop so that they are developed on how to utilise Turnitin in assessing mathematics. If lecturers assess content based on students' knowledge like critique the of lessons plans and observation of the lessons presented, they are supposed to utilise Turnitin as well, in order to check plagiarism from students' work. If students realise that their lecturers do not utilise Turnitin to check for similarities, they might copy other people work. It therefore, wise for lecturers to utilise Turnitin in order to deny student the opportunity of plagiarism by Razi (2015). This action might prevent students from taking instructions and guidance from other students. If students are not familiarised with Turnitin, learners in schools will not learn about academic integrity as indicated by Canzonetta and Kannan (2016). These students are expected to bring about change in schools, introducing new ways of assessment through Turnitin. This shows a time gap between lecturers and students, as students are motivated by Turnitin to hand in their work (Chew et al., 2015). In addition, mathematics lecturers need an awareness that Turnitin is currently assisting high school teachers and university lecturers and professors everywhere, bringing academic integrity back into classrooms and lecture rooms (Canzonetta & Kannan, 2016).

On the other hand, it is surprising that these lecturers are even aware of Turnitin. Similarly, these findings concur with Ranawella and Alagaratnam (2017) who argue that some lecturers are not

used to Turnitin because, even though they know about bit, many staff members do not have computer application skills. Bemmel (2014) further adds that Turnitin in not used because of lack of familiarity, mistrust of technology, as well as lack of knowledge on Turnitin and its functionality. In fact, for lecturers to use digital technologies they need support and specific training to understand the effective use of technology in teaching practice (Ravanelli, 2019), specifically in mathematics. This suggests that there is a need for lecturers to be taught TPACK development stages for them to be hands on in mathematics. These stages are recognising (knowledge), accepting (persuasion) adapting (decision), exploring (implementation) and advancing (confirmation) (Alshehri, 2012; Kafyulilo, 2010; Kapp, 2015; Niess et al., 2009; Saralar et al., 2017). In the recognition stage, lecturers begin to recognise the importance of technology for enhancing teaching (Ndongfack, 2015); however, such lecturers do not incorporate technology into the process of mathematics assessment. In the accepting stage, it rests on the lecturers' experience and decision, to adopt, or not, assessment of mathematics utilising Turnitin (Alshehri, 2012; Kafyulilo, 2010). In addition, for lecturers to be engaged in the adapting stage, they need to discover their identity in terms of their in-depth prior knowledge and clear understanding of the benefits of assessing using technology (Alrwaished et al., 2017; Kapp, 2015). The development of the above-mentioned stages might assist lecturers to evaluate results of integrating the assessment of mathematics through Turnitin. In mastering these stages, lecturers would be able to use Turnitin during free periods, own time, and after working hours. As the findings indicated, lecturers have the ability to use the platform effectively at any time of the day.

However, the findings show that most of the lecturers have the same problems in terms of assessment in mathematics utilising Turnitin; and they have similar views about the understanding of Turnitin utilisation. The lecturers indicated that Turnitin is utilised for checking whether students did not plagiarised. The difference is that lecturers have different reasons for understanding use of Turnitin. For example, two of the lecturers indicated that they would like to utilise Turnitin, only, they have no idea of utilising Turnitin. This indicated a positive attitude towards utilisation of Turnitin. It is a sign that such lecturers need professional development in order to integrate technology into the content they are teaching. Such lecturers are not compelled to use the old method of assessment because they lack understanding of integrating technology, pedagogy, as well as content. As De Freitas and Spangenberg (2019) declare, many South African

teachers lack TPACK in mathematics. This lack of understanding might contribute to the minimum use of TPACK in mathematics. This might be the reason for learners being exposed to traditional delivery of content by teachers. Learners are also denied such teaching strategies that promote collaboration, communication, and the sharing of ideas through information and communication technologies. This is owing to insufficient and inappropriate professional development opportunities for teachers to improve their TPACK (De Freitas & Spangenberg, 2019). Such lecturers are not in the position of producing future teachers who would fit into this era of the 4IR. One lecturer displayed a lack of interest in utilisation of Turnitin, by indicating that in mathematics the technology does not work well, mathematics involving common symbols, numbers, equations, terminologies, and vocabulary, as well as theorems. The last lecturer also demonstrated a negative attitude towards utilising Turnitin. This lecturer indicated that she does not encourage students to utilise Turnitin because of her own perception that if she introduces students to Turnitin, they will learn many tricks to manipulate Turnitin. This statement accords with Baturay et al. (2017), who argues that bringing the necessary technology into educational settings does not guarantee effective teaching and learning. This lecturer is provided with Turnitin to assist in assessment; however, the lecturer has decided not to utilise it, indicating personal understanding. These findings indicate that all lecturers need educational pragmatism in order to improve their knowledge of how to integrate Turnitin effectively. Lecturers should develop positive beliefs and attitudes on integration of Turnitin into teaching and learning of mathematics (Karakus, 2018). Higher education institutions need to follow up on TPACK, focusing on understanding how lecturers use their TPACK in what they do with technology in practice, and why they do such (Voogt et al., 2015). In this respect, the three questions were answered; and these questions were used as guidelines of assessment that assisted lecturers to understand their identities.

6.4 Recommendations and Contributions for the Study

- In connection with the findings of this study, it was found that the policy has limitations in some areas. First, the policy fails to be specific on the software to be utilised in assessing mathematics. This error has resulted in lecturers neglecting the utilisation of Turnitin in mathematics. This, in turn, has infringed on students' rights to achieve the required outcomes for Turnitin utilisation in mathematics.

- Second, the policy is limited in terms of the content to be assessed specific to mathematics – it is too general. Mathematics is different from other subjects, involving figures, symbols, graphs, equations, and theorem terminology common to the entire world. Turnitin is not useful for similarities in mathematics, but it is useful for assessment. Therefore, the plagiarism policy needs to be reviewed to accommodate mathematics so that it become easier for mathematics lecturers to utilise Turnitin. Required skills stipulated to be assessed are acquired in mathematics. In addition, although the policy specifies the role of the members of staff, it is limited. There is no indication of the follow-up on whether every mathematics lecturer has attended the Turnitin training organised by the university. Application of Turnitin lies in the hands of lecturers' implementation. It is recommended that the policy reveal exactly what is expected from lecturers, revising the training programmes to focus on mathematics, specifically in terms of Turnitin utilisation.

- Third, the policy fails to specify the exact resources to be used in mathematics. As a result, Turnitin software is not utilised for assessment in mathematics. Instead, lecturers only use other software like Google Classroom, Google Form, or Moodle for teaching and learning. This might have a negative impact on students who are future teachers needing to be prepared for the transmission of knowledge gained, and skills from the university in terms of utilising technology such as Turnitin software and its application in mathematics.

- Last, thinking people use the generated theory for Turnitin utilisation. This can also pave the way towards addressing gaps of utilising Turnitin software in various subjects such as mathematics, physical science, and engineering.

6.4.1 Recommendations

Investigate training(s) relevant to the subject for Turnitin utilisation, ensuring full attendance.

Turnitin needs to be upgraded with translation features for different languages.

Conduct more studies on lecturers' utilisation of plagiarism-detection tools.

More text from a broader collection of mathematics is needed. Data generated was minuscule, and did not include many different disciplines such as engineering and technology.

Future research should include a larger sample and participants from other universities.

Lastly, an in-depth study based on a quantitative approach is recommended.

6.5 Implications of this Study

The implications of the study are summarised as follows:

- Turnitin cannot be used for similarity index in mathematics, because of the commonalities of symbols, numbers, graphs, equations, theorems and terminologies. For these reasons, Turnitin can be used for assessment to check for the correctness rather than manual detection. Turnitin cannot be used for checking similarities in mathematics, because of the common terminologies, vocabulary, symbols, numbers, graphs, equations, and theorems. For these reasons Turnitin can be used for checking the correct answer rather than detecting plagiarism.
- Turnitin, as a software tool, can help to correctly assess; it can assess many papers in a short period compared with manual assessing.

- Turnitin needs to be upgraded to include features like translating into other languages.

- Mathematics lecturers should not only learn current teaching and learning tools but adapt themselves to the new teaching techniques and skills as the old and current tools become outdated. TPACK, for example, added technology to Shulman's model, so that lecturers could familiarise themselves with 4IR.

- The universities have a huge responsibility to ensure that lecturers attend Turnitin training workshops and seminars organised by universities specific to mathematics; to acquire the skills for handling Turnitin. This might assist lecturers to be able to integrate technology (Turnitin) into the content for assessment in mathematics.

- The university should take the responsibility to check plagiarism of student work; not relying on lecturers who are already overloaded with a large number of students.

6.6 Concluding Remarks

The core aim of the study was to assess lecturer's understanding and how these understandings affected the implementation of Turnitin, as prescribed in the policy. The study attempted to bridge

the gap between reducing and preventing plagiarism and what is actually taking place in teaching practice concerning Turnitin utilisation. The findings of this study highlighted the importance of using a case study to unearth what is happening in reality. A case study facilitated in-depth exploration of a real-life existing phenomenon in its natural context (Yin, 2012). This study empowered two lecturers who became aware of Turnitin software essential as an assessment device.

This is the first case study on eliciting lecturers' understanding of mathematics at a South African university. The case study should be adopted to understand how the lecturers interpret the way they work in field of mathematics; and also to understand the challenges they are faced with in terms of utilising Turnitin in mathematics in their teaching environment.

The case study should be adopted by other studies to explore its effectiveness with regard to utilisation of Turnitin. Findings of this study should enlighten various educational stakeholders in KwaZulu-Natal in promoting the use of case study in different contexts and learning areas which are similar to mathematics. The theory of Turnitin utilisation presented in Chapter 3, as well as in paragraph 6.2 of this chapter can be used in different disciplines with reference to integrating curriculum concepts in practice.

The results suggested that lecturers should not be blamed if plagiarised work is not detected. Lecturers are to concentrate on teaching students to become teachers; lecturers are not detectives. Lecturers from all disciplines need to be included in the decision-making concerning the formation of the plagiarism policy. This implies that lecturers, must be involved in policy development and design in order to address their concerns. Lecturers should be in a position to understand the integration of content knowledge (professional), pedagogical knowledge (private), and technological knowledge (public), in order to have a fuller understanding of Turnitin utilisation as part of assessment.

Last, the study highlighted the importance of the curriculum concepts and their respective reasons of assessment. The literature reveals that each concept has three propositions that guide lecturers in detection plagiarism in terms of balancing assessment processes. It became evident from the

literature that Turnitin is utilised for three reasons: to detect and punish, detect and educate, and detect and share. These reasons would assist lecturers to use the curriculum concepts, being aware of such reasons in balancing their assessment practice. It is therefore important that the university and curriculum implementers become aware of the curriculum concepts, as well as the three reasons for assessment, in order to assess effectively.

6.7 Summary

This chapter attempted to interpret and theorise the findings, giving a summary of the findings, addressing the research questions, implications, and concluding remarks of this study. The results of the study indicate that Turnitin is utilised for Professional, private and public understanding. In addition, the findings reveal that students were not given a chance to apply their knowledge in terms of utilising Turnitin in mathematics. In terms of content, Turnitin is lacking translation features. Furthermore, the resources used for assessment in mathematics are human resources and manual detection instead of Turnitin. The results of the study also reveal the importance of integrating content detection knowledge in mathematics (TCDKM) and manual content detection knowledge into mathematics education (MCKDM). In terms of TPACK the study reveals that there are areas where it does work well because of the content that is used, like in mathematics. Therefore, the new knowledge revealed from the study is that, there are two ways in Turnitin utilisation for assessing mathematics. This is technology detection (professional understanding) and manual detection (private understanding) in order to address to balance the two types of detection in mathematics.

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Appendix 1: Reflective activity

Concepts	Questions	Lecturers reflection
1. Rationale	What do you understand about utilising Turnitin in assessing Mathematics?	Professional understanding Personal understanding Public understanding
2. Vision	How do you understand the utilisation Turnitin is assessing Mathematics?	Professional understanding Personal understanding Public understanding
3. Goals	Why do you understand Turnitin in assessing mathematics in particular way?	Aims objectives outcomes
4. Content and activities	What content and activities do you assess utilising Turnitin in Mathematics?	Geometry algebra trigonometry
5. Assessment	How do you assess utilising Turnitin in Mathematics?	Summative Formative Peer
6. Teaching methods	Which methods do you use utilising Turnitin in assessing Mathematics?	Product Process critical
7. Lecturers	What role do you play in assessing utilising Turnitin in Mathematics?	Instructor Facilitator Researcher/collaborator
8. Platform	Where do you assess utilising Turnitin in Mathematics?	Face to face environment Outside environment Blending environment
9. Time	When is Turnitin utilised in assessing Mathematics?	Working hours Spare time After hours
10.Resources	What resources do you use, utilising Turnitin in Mathematics?	Hardware Ideological-ware software

Appendix 2: Interview Tool

Name of participant (pseudonyms): _____

Gender: _____

Number of years in teaching: _____

Faculty: _____ Module: _____

Date: _____ Time and Duration**:** _____

Question1

Rationale: Why do you understand utilisation of Turnitin in assessing mathematics in particular ways?

1. What professional rationale/reason that made you understand utilisation of Turnitin in assessing mathematics?
2. What personal (private) rationale that made you understand utilisation of Turnitin in assessing mathematics?
3. What societal (public) rationale /reason that made you understand utilisation of Turnitin in assessing mathematics?

Question 2

Goals: Towards which goals do you understand about utilising Turnitin in assessing Mathematics**?**

1. What are your aims of understanding Turnitin utilisation in assessing mathematics?
2. What are the objectives of understanding Turnitin utilisation in assessing mathematics?
3. What are the outcomes of understanding Turnitin utilisation in assessing mathematics**?**

Question 3

Content: What content do you assess in Mathematics utilising Turnitin?

1. What do you understand about professional content in assessing mathematics utilising Turnitin?
2. What do you understand about private content in assessing mathematics utilising Turnitin?
3. What do you understand about public content in assessing mathematics utilising Turnitin?

Question 4

Activities: What activities do you assess in Mathematics utilising Turnitin?

1. What do you understand about professional activities in assessing mathematics utilising Turnitin?
2. What do you understand about private activities in assessing mathematics utilising Turnitin?
3. What do you understand about public activities in assessing mathematics utilising Turnitin?

Question 5

Assessment: how do assess content activities in Mathematics utilising Turnitin?

1. What do content activities do you assess during assessment of teaching mathematics utilising Turnitin?
2. What do content activities do you assess during assessment for teaching mathematics utilising Turnitin?
3. What do content activities do you assess during assessment as teaching mathematics utilising Turnitin?

Question 6

Procedures: Which procedures do you use in assessing mathematics utilising Turnitin? (methods)

1. Which procedure do you use during assessment of teaching mathematics utilising Turnitin?
2. Which procedure do you use during assessment for teaching mathematics utilising Turnitin?
3. Which procedure do you use during assessment as teaching mathematics utilising Turnitin?

Question 7

Lecturers: What role do you play in assessing mathematics utilising Turnitin?

1. What professional role do you play in assessing mathematics utilising Turnitin?
2. What private/ personal role do you play in assessing mathematics utilising Turnitin?

3. What public/ societal role do you play in assessing mathematics utilising Turnitin?

Question 8

Platform: Where do you assess mathematics utilising Turnitin? (environment)

1. Do you assess mathematics utilising Turnitin using inside platform?
2. Do you assess mathematics utilising Turnitin using online platform?
3. Do you assess mathematics utilising Turnitin using blended platform?

Question 9

Intervals: When do you assess mathematics utilising Turnitin? (time)

1. When do you assess mathematics utilising Turnitin using working period?
2. When do you assess mathematics utilising Turnitin using your spare time?
3. When do you assess mathematics utilising Turnitin using after work hours?

Question 10

Resources: what resources do you use when assessing mathematics utilising Turnitin?

1. What hardware resource do you use in assessing mathematics utilising Turnitin?
2. What teaching theories resource do you use in assessing mathematics utilising Turnitin?
3. What software resources do you use in assessing mathematics utilising Turnitin?

Appendix 3: Application letter for permission

A10 Mdoni Road

KwaNdengezi Township

3607

3 August 2018

The Registrar

Private Bag X54001

Durban

South Africa

4001

Application for permission to conduct a research

I am Tinyiko Hopedivine Zuma presently teaching at Bhongo Primary school. I am studying for PhD in Curriculum studies through Edgewood University of Natal under the supervision of Dr. Simon B. Khoza. My research topic is "An exploration of lecturers' understanding of Turnitin utilisation in teaching Mathematics at a South African university". The main purpose of the study is to explore lecturers' understanding of Turnitin utilisation in teaching Mathematics at a South African university.

I would like to do a case study at one of the University of KwaZulu-Natal from August to September 2018. Volunteered participants who are teaching Mathematics will be interviewed and observed during their suitable time. This study will entail an interview session that will take duration of 30 minutes per participant as well as observation session that will take a duration of 45 minutes per participant. Every effort will be made not to disturb daily functioning of the university. Confidentiality and anonymity of the participants will be maintained during the process of this research project.

- Confidentiality is guaranteed as contributions will not be attributed to participant in person, but reported only as population member option.

- Document analysis, semi-structured interview, semi-structured observation may last for about 45 minutes.
- Any information given cannot be used against the university, and the collected data will **ONLY** be used for purposes of this research.
- There will be no limit on any benefit that you may receive as part of participation in this research project.
- Data will be stored in secure storage and destroyed after 5 years.
- Participants will a choice to participate, not participate or stop participating in the research. they will not be penalized for taking such an action.
- they are free to withdraw from the research at any time without any negative or undesirable consequences;
- Your real names will not be used, but symbols such as A, B, C, D, E and F will be used.
- The research aims at knowing the challenges of your community relating to scarcity, peoples' movement, and effects on peace.
- University and lecturers' involvement is purely for academic purposes only, and there are no financial benefits involved.

I hope that my request will be viewed favourably

Your faithfully

Tinyiko Hopedivine Zuma

Student Number: 982207092

Email Address : tinyikozuma@gmail.com

Cell phone Number: 076730515

Student Signature:  Date: 3/08/2018

Supervisors details:

Dr Simon B. Khoza

Email Address : khozas@ukzn.ac.za

Cell phone Number: 031 260 7595

Supervisors Signature: _____ Date: _____

Appendix 4: Letter to participant

T. H. Zuma (Mrs.)

A10 Mdoni Road

KwaNdengezi

3607

25/03/ 2019

Dear Participant (lecturer)

INFORMED CONSENT LETTER

My name is Tinyiko Hopedivine Zuma I am a student at the University of KwaZulu-Natal, Edgewood Campus. I am studying for PhD degree of Education in curriculum studies under the supervision of Prof. S. B Khoza. This research explores lecturers' understanding of Turnitin utilisation in assessing Mathematics, which many university lecturers encounter when students up load their assignments, dissertations. I am kindly requesting you to answer some questions based on your understanding of Turnitin utilisation in assessing Mathematics as I am also teaching Mathematics. Your participation in this study will entail an interview session that will take duration of 30 minutes. As well as observation session that will take a duration of 45 minutes.

Please note that:

- Your confidentiality is guaranteed as your contributions will not be attributed to you in person, but reported only as population member option.
- Document analysis, semi-structured interview, semi-structured observation reflective may last for about 45 minutes.
- Any information given cannot be used against the university, and the collected data will **ONLY** be used for purposes of this research.
- There will be no limit on any benefit that you may receive as part of participation in this research project;

- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.
- You are free to withdraw from the research at any time without any negative or undesirable consequences;
- Your real names will not be used, but numbers such as L1, L2, L3, and L4, will be used.
- The research aims at knowing the challenges of your community relating to scarcity, peoples' movement, and effects on peace.
- University and lecturers' involvement is purely for academic purposes only, and there are no financial benefits involved.
- If you agree to be interviewed and to be observed please indicate by ticking whether you agree or not, to be recorded by the following equipment

The following work plan will be used to complete this research project:

Equipment	**Willing**	**Not Willing**
Tape recorder		
Photographic (camera)		

cell phone 076 7330515 or E-mail: tinyikozuma@gmail.com. If you have questions regarding your rights as research subjects or if problems arise which you do not feel to discuss with me.

You can contact my supervisor: Dr. S. B Khoza 031 260 7595 or khozas@ukzn.ac.za who is located at School of Education, Edgewood campus of the University of KwaZulu-Natal.

DECLARATION

I……..…… (Full names of Participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participate in the research project. I understand that I am at liberty to withdraw from the project at any time, should I desire.

…….. ……..

SIGNATURE OF PARTICIPANT DATE

Appendix 5: Gate Keeper Letter

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

7 August 2018

Mrs Tinyiko Hopedivine Zuma (SN 982207092)
School of Education
College of Humanities
Edgewood Campus
UKZN
Email: tinyikozuma@gmail.com khozas@ukzn.ac.za

Dear Mrs Zuma

RE: PERMISSION TO CONDUCT RESEARCH

Gatekeeper's permission is hereby granted for you to conduct research at the University of KwaZulu-Natal (UKZN) towards your postgraduate studies, provided Ethical clearance has been obtained. We note the title of your research project is:

"An exploration of Lecturers' understanding of Turnitin utilization in teaching Mathematics at a South African University."

It is noted that you will be constituting your sample by conducting observations and/or interviews with Mathematics academic staff on the Edgewood Campus.

Please ensure that the following appears on your notice/questionnaire:

- Ethical clearance number;
- Research title and details of the research, the researcher and the supervisor;
- Consent form is attached to the notice/questionnaire and to be signed by user before he/she fills in questionnaire;
- gatekeepers approval by the Registrar.

You are not authorized to contact staff and students using 'Microsoft Outlook' address book. Identity numbers and email addresses of individuals are not a matter of public record and are protected according to Section 14 of the South African Constitution, as well as the Protection of Public Information Act. For the release of such information over to yourself for research purposes, the University of KwaZulu-Natal will need express consent from the relevant data subjects. Data collected must be treated with due confidentiality and anonymity.

Yours sincerely

MR SS MOKOENA
REGISTRAR

Appendix 6: Ethical Clearance

UNIVERSITY OF
KWAZULU•NATAL
INYUVESI
YAKWAZULU.NATALI

1 October 2018

Mrs Tinyiko Hopedivine Zuma 982207092
School of Education
Edgewood Campus

Dear Mrs Zuma

Protocol reference number: HSS/1115/018D
Project title: An exploration of lecturers' understanding of Turnitin utitisation in teaching Mathematics at a South African university

Full Approval — Expedited
Application In response to your application received 3 August 2018, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....

Professor Shenuka Singh (Chair)

Humanities & Social Sciences Research Ethics Committe

/pm

cc Supervisior: Dr SB Khoza cc. Academic Leader Research: Dr SB Khoza cc. School Administrator: Ms Sheryl Jeenarain

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Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
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Telephone: +27 (0) 31 260 3587/8350/4557 Facsimile: +27 (0) 31 260 4609 Email:ximbap@ukzn.ac.za snmanm@ukzn.ac.za I mohunp@ukzn.ac.za Website: www.ukzn.ac.za

Appendix 7: Turnitin report