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TECHNOLOGY-ENGAGEMENT TEACHING STRATEGY USING PERSONAL RESPONSE SYSTEMS ON STUDENT'S APPROACHES TO LEARNING TO INCREASE THE MATHEMATICS PASS RATE

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ABSTRACT

Aim/Purpose	The purpose of the current study was to investigate whether the effectiveness of the Technology-engagement Teaching Strategy using personal response systems with student's approaches to learning will increase the pass rate in the Mathematics course
Background	The challenge in this study was to develop the learning activities that accommodate individual differences and diversity in learning. Furthermore, Studies investigating students' approaches to learning have mostly done this in a face-to-face learning environment as opposed to incorporate exploration thereof when integrating educational technology.
Methodology	A mixed method approach was used. The basis of using this method was a combination of quantitative and qualitative approaches which gives a clearer understanding of research problems than either approach alone. Participants were 240 students registered for Mathematics II at a study University of Technology in South Africa. Purposeful, convenience and simple random sampling were used to select the participants.
Contribution	No study that has investigated the utility of personal response systems with students' approaches to learning is currently available as observed by the researcher. In this case, the combination of the two variables in this study makes it unique and therefore important in contributing to the body of knowledge focusing on the role of technology in pedagogy.

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Findings	The results showed that while the majority of students followed the Strategic Approach the same Technology-engagement Teaching Strategy was used for students following Surface Approaches. The Technology-engagement Teaching Strategy was developed in such a manner to accommodate students following different approaches. The personal response system continuous assessments, as well as the semester test, revealed the improvement in academic performance as well as the increase in mathematics pass rates. It was also found that using personal response system enhances students' mathematical communication skills, and helps to develop the skills needed to write and read mathematical proofs.
Recommendations for Practitioners	It is recommended that academics take into consideration the students approaches to learning in their teaching practices. It is crucial that lecturers take advantage of technology to enhance their teaching practices and decrease the fear of the unknown and open up to new innovations in teaching.
Recommendations for Researchers	It is recommended that the use of personal response systems should be explored in different mathematics settings (different lectures and universities). Such an exploration according to the researcher will be useful in endorsing what has been reported in this paper.
Impact on Society	The results revealed that the Strategic Approach was the most dominant among the participants in this study. The results also showed the improvement in students' academic performance as well as the number of students who passed increased.
Future Research	A further research study could be conducted with students in a different discipline where poor academic performance is experienced.

Keywords teaching strategy, personal response systems, students' approaches to learning, mathematics, higher education

INTRODUCTION

Globally, it is argued that technology in schools and higher education institutions is revolutionizing education (Agrawal, 2019). This implies that the educational environment is transforming with a rapid increase in technological advancement driven by the 4th Industrial Revolution (Daniela, Strods, & Kalniņa, 2019, Mokoena, Simelane-Mnisi, & Coetzer, 2019). The benefits of using technology in education can no longer be denied as it infiltrates every area of our lives. In fact, the advantage of using technology in education is that technology enhances the fun in learning, better prepares students for the future, promotes interaction and engagement, allows for self-paced and personalized learning and students remain connected (Agrawal, 2019).

The Technology-engagement Teaching Strategy is a rich and flexible teaching strategy that was created with the integration of personal response systems (Simelane & Skhosana, 2012). Its purpose was to support students to develop active learning and higher order thinking (Gordy, Jones, & Bailey, 2018; Simelane, Mji, & Mwambakana, 2011). The Technology-engagement Teaching Strategy (TETS) also aims to support lecturers at higher education institutions (HEIs) to improve their teaching methods. The idea is to better prepare students to succeed in today's global economy, improve skills required in the 21st century and be competitive in the 4th Industrial Revolution (Gleason, 2018; Simelane-Mnisi & Mji, 2016). Creativity, communication, critical thinking, collaboration, problem-solving, innovation, and computational skills were promoted using TETS (Hardman et al., 2018). Research reveals that a successful 21st-century lecturer should be a master of teaching with technology or Information Communication Technology (Curtis, 2019; Hardman, et al., 2018). The personal response systems (PRS) are currently available on the emerging mobile technologies such as mobile devices, and they are used in the form of an App for these devices and require Internet or Wi-Fi access (Chan & Ko, 2019; Doersam, 2015; Simelane-Mnisi & Mji, 2017a). It is argued that PRS could be used close to each other in the classroom, because of some technical challenges brought about by these technologies (Stowell, 2015). PRS bring about live interactive teaching and learning in-class with meaningful feedback to the lecturer and students (Simelane-Mnisi & Mji, 2016). In this study, PRS from Turning Point Technologies, that utilizes radio frequency to record audiences' responses to questions was used (Mnisi, 2015). PRS were used because the classrooms were not Internet-enabled. Students were issued with PRS at the beginning of the semester. They were registered or recorded on the PRS with their student numbers and connected with the device numbers. They used their devices in-class to respond to questions posed by the lecturer on the PowerPoint presentation.

The approaches to learning paradigm (Biggs, 1987; Martin & Säljö, 1976) are the most widely used frameworks for understanding student learning in HEI. Students' approaches to learning are reported to be influenced by a number of factors such as studying and the level of understanding is influenced by teaching, assessment and the teaching environment (Entwistle, 2000; Han & Ellis, 2019). For lecturers to encourage more conceptual, deeper forms of learning, they need to understand how students approach learning (Teixeira, Gomes, & Borges, 2013). Studies investigating this variable have mostly performed this on a face to face learning environment as opposed to also exploring it against the integration of educational technology (Buckley, Pitt, Norton, & Owens, 2010; Simelane-Mnisi & Mji, 2017b; Tlhapane & Simelane, 2010). This paper sought to address the effects of the two variables (a) approaches to learning and (b) use of technology in teaching] on each other to improve the pass rate. It was on this basis that the students' approaches to learning were explored against the strategy involving PRS. In this study student's approaches to learning were identified through using the short version of Approaches and Study Skills Inventory for Students (ASSIST).

The challenge in this study was to develop the learning activities that accommodate individual differences and diversity in learning. The purpose of this study was to investigate whether the effectiveness of the TETS using PRS with students' approaches to learning increase the pass rate in the mathematics course. In order to do this, firstly, student's approaches to learning were distinguished using the Approaches and Study Skills Inventory for Students. Secondly, TETS using PRS was developed to create learning activities that accommodated various approaches to learning. Thirdly, weekly PRS continuous assessments were conducted in order to establish the changes in students' academic performance. To establish students' academic performance the semester test results were also used. Finally, students' perspectives towards the use of PRS in a Mathematics course were examined using the survey questionnaire.

RELATED LITERATURE

TEACHING STRATEGIES

Theorists Lasry, Mazur, and Watkins (2008) point out that teaching strategies are about the approaches academics, lecturers, teachers and instructors follow to create environments conducive to learning. In this regard, literature (Marti, Sherman, & Stephen, 2019) identify a number of strategies that are used in the teaching and learning context. These strategies questioning techniques, physical models, lecturer movement, group work, feedback, cooperative learning, collaborative learning, experiential learning, discussion, and inquiry guided teaching (Marti, et al., 2019; Goodwin 2018). In essence, lecturers choose a teaching strategy depending on the information or skill they want to communicate to students (Mnisi, 2015). The critical aspect of the teaching strategy is that lecturers should ensure that students understand concepts and that they can reason and process information in order to apply it in real-life situations (Simelane-Mnisi & Mji, 2014).

What lecturers should reminisce though is that students of the 21st Century are techno-high. This implies that in the world of today, students are envisaged to gain mastery over a new set of skills relating to problem-solving, digital literacy and, critical thinking (Nishantsinha, 2018). This author argues that it is critical that students know how to communicate, collaborate, and present their ideas to navigate through various challenges in the real world. In most instances, these students are generally using technology such as the Internet and social media or technological equipment like smartphones and iPads (Mnisi, 2015). In order for lecturers to adapt and adjust to innovative teaching to accommodate students, they are advised to incorporate a range of effective and advanced teaching strategies to encourage the students to use such skills (Nishantsinha, 2018). It is important therefore, that as lecturers select teaching strategies they should consider incorporating advanced and appropriate technology.

TECHNOLOGY-ENHANCED TEACHING STRATEGY

Literature reveals that technology-enhanced teaching strategies are models for teaching with technology (Mnisi, 2015). The advancement of technology in education has posed challenges that require academics to intervene (Rawlins & Kehrwald, 2014). In fact, in order to avoid poor integration of technology into teaching and learning, it is essential that lecturers select appropriate teaching strategies with relevant technology (Simelane, 2008a; 2008b). In this regard, it is argued that lecturers require classroom communication system-based teaching CCS also known as PRS (Beatty, 2004). This author reveals that this strategy was developed because of the traditional teaching methods used by lecturers to teach in large classes. He further elaborates that teaching large classes with traditional teaching methods such as small groups, individual attention, and discussion was impractical and the outcomes of the lesson became the focus of the class activity (Beatty, 2004). This was problematic because, in teaching, the focus should be on students' conceptual understanding and the process and reasoning of information. So, when Beatty (2004) developed question-cycle instruction, the reason behind it was that PRS would be able to accommodate large classes, and discussions would be more effective, similar to small groups.

The TETS was a rich and flexible teaching strategy that was created with the integration of PRS (Simelane & Skhosana, 2012). Its aim was to assist students to develop active learning and higher order learning (Simelane, et al., 2011). The TETS also aimed at assisting lecturers to improve their teaching methods in order to better prepare students for success in today's global economy and improve skills required in the 21st century (Simelane-Mnisi & Mji, 2016). The correct incorporation of TETS using PRS bridged the gap between knowledge of technical skills, good pedagogy, and content knowledge (TPACK) (Mnisi 2015; Mishra & Koehler, 2006). The TETS using PRS helped the lecturers to distinguish exactly how to include the four components (students, lecturers, course content and technology tools) in their teaching practices. It is worth noting that the focus here was not on the PRS technology but on the teaching and learning process (Henke 2001).

When using PRS in teaching and learning, it is not the actual technology that works, but rather the assistance with the correct incorporation of technology in teaching and learning. The correct incorporation of technology will bridge the gap between knowledge of good pedagogy, technical skills and content knowledge (Mishra & Koehler, 2006). Furthermore, lecturers will have to know exactly how to include the four components (students, lecturers, course content and technology tools) that are essential in technology-enhanced teaching strategies (Mnisi, 2015). Examples of technology-enhanced teaching strategies are Technological, Pedagogical and Content Knowledge (TPACK) (Mishra & Koehler, 2006), Technology Acceptance Model (Davis, 1989), blended learning (Alvarez, 2005), online learning (Anderson, 2010), Synthesis of Qualitative Evidence model (SQD) (Tondeur et al., 2012) and networked-based pedagogies (Saadatmand & Kumpulainen, 2012). In this study, the researcher identified the use of PRS as an appropriate technology as teaching strategy. The basis for selecting PRS as an appropriate technology as teaching strategy was embedded within the utility of these gadgets and that the classrooms were not Internet or Wi-Fi enabled. Furthermore, these gadgets had a likelihood to accommodate individual differences and diversity in learning.

PERSONAL RESPONSE SYSTEMS TEACHING STRATEGIES

PRS teaching strategies are teaching app roaches that integrate PR S in teaching and learning (Simelane & Skhosana, 2012). Few studies have examined the teaching strategies using PRS (Beatty & Gerace, 2009; Kulatunga, & Rameezdeen, 2013; Mnisi, 2015). These strategies include the peer instruction and concept-test model (Mazur, 1997), question cycle instruction (Beatty, 2004), Technology-Enhanced Formative Assessment (TEFA) (Beatty & Gerace 2009), and Technology-engagement Teaching Strategy (TETS) (Simelane et al., 2011). These strategies are also referred to as 'interactive teaching strategies' (Mazur, 1997) It is reported that these strategies stimulate students' active engagement in class with lecturer and peers (Cheung, Wan, & Chan, 2018; Farag & Park, 2015). Peer instruction was used in conjunction with Concept Test (Mazur, 1997). Regarding traditional. teaching methods, Mazur (1997) argues that he used the lecture method in imitation of how he was taught, reading from the textbook and transmitting knowledge in a one-way mode (Tudor, 2013). The students were not involved in the lessons. Caldwell (2007) points out that peer instruction is a student-cent red approach to teaching that provides real-time feedback to multiple-choice questions (MCQs) known as ConceptTests.

Question-cycle instruction is a teaching strategy for organizing classroom communication system based teaching CCS also known as PRS (Beatty, 2004). This author reveals that this strategy was developed, because of the traditional teaching methods used by lecturers to teach in large classes. He further states that teaching large classes with traditional teaching methods such as small groups, individual attention, and discussion was impractical and the outcomes of the lesson became the focus of the class activity (Beatty, 2004). This was problematic because, in teaching, the focus should be on students' conceptual understanding and the process and reasoning of information. So, when Beatty (2004) developed question-cycle instruction, the reason behind it was that PRS would be able to accommodate large classes, and discussions would be more effective, similar what occurs when teaching small groups.

Opportunity of the interaction is linked to the active learning methods (Green & Sammons, 2014). PRS assist lecturers to move from teacher-centered approaches to more learner-centered approaches in teaching as well as to promote active learning (Mnisi, 2015). In this regard, it is argued that PRS, when used in class, positively, influence student engagement and also provoke deep and active learning among students (Green, Chang, Tanford, & Moll, 2015). So, it is mentioned that if deep learning is encouraged in learning, surface learning among students could be reduced (Simelane, et al., 2011). It is argued that student response systems are effective and helpful in keeping students active in class through activities and help in the improvement of the critical thinking abilities of students (Pisheh, NejatyJahromy, Gargari1, Hashemi, & Fathi-Azar, 2019).

It was reported that 91% of PRS questions were implemented using peer discussion in the study conducted by (Solomon, et al., 2018). These authors also found that in other subjects individual thinking was also applied. It may be argued that PRS could be used with a variety of teaching strategies to promote active learning. It was also reported that the learner interface, lecturer attitude toward learners, and lecturer technical competence significantly influence learners' learning performance when PRS are used in teaching and learning (Chan & Ko, 2019).

STUDENTS' APPROACHES TO LEARNING

Researchers such as Biggs (1987); Entwistle, McCune, and Tait (2006); Entwistle (1996); Martin and Säljö (1976) were amongst the first researchers to outline the students' approaches to learning, the quality of their learning outcomes and their prior experiences. This theorist points out that students learn (in the way they do), because of their understanding of a situation and in a way that determines their approaches to a task. Several studies continuously provide evidence that individual differences occur in the way students approach learning, that also involves Deep, Strategic and Surface learning (Simelane et al., 2011; Teixeira et al., 2013; Venkatesh, Croteau, & Rabah, 2014). When students adopt these approaches to learning, it encourages their belief systems, such as success expectations and self-regulatory skills (Hailikari & Parpala, 2014). It has been stated that students following the Surface learning approach often learn to remember facts, identify aspects and focus on what they were taught (Simelane, et al., 2011). Hailikari and Parpala (2014) reveal that students with a Deep approach to learning aim to understand the teaching and learning environment as well as a subject matter more positively than students with the Surface approach. Academic performance, top achievement as well as using good time management and organized study methods tend to be positively associated with the strategic learning approach (Bolkan, Goodboy, & Griffin, 2011; Entwistle, 2000; Mogashana, Case, & Marshall, 2012).

Buckley et al. (2010); Mnisi (2015); Tlhapane and Simelane (2010) reveal that educational technologies and research on students' approaches is mostly done in a face-to-face learning environment as compared to investigating students' approaches to learning with the incorporation of educational technologies. However, it was reported that students who follow the Deep and Strategic approaches to learning were more comfortable with a blended learning environment than students who adopted a Surface approach (Buckley, et al., 2010). Similarly, it was also stated by Venkatesh et al. (2014) that there were no significant relations between study approaches and perceptions of Information Communication Technology (ICT) usefulness, although students using the Deep learning approach indicated a higher appreciation of ICT integration in a course. These studies (Buckley et al., 2010; Venkatesh et al., 2014) used Approach and Studying Skills Inventory for Students (ASSIST) to measure students' perceptions towards ICT tool usage as well as blended learning.

Students' approaches to learning inventories contribute to the measurement of students' study methods and approaches by offering to persuade empirical evidence important to inform policy decisions in HEIs (Teixeira et al., 2013). These study learning inventories are attractive for the apparently simple route they provide into understanding what students are thinking and doing in a classroom (Mogashana et al., 2012). The example of the measuring instruments that have been used to measure students approaches to learning in HEIs include the Revised Approach to Learning and Studying Inventory (RASI) (Duff, 2004; Mattick, Dennis, & Bligh, 2004); the Study Process Questionnaire (SPQ) (Biggs, 1994); the Approaches to Studying Inventory (ASI); the Approach and Studying Inventory for Students (ASSIST); Lancaster Approach to Studying Questionnaire; and Raven's Standardized Progressive Matrices (sets A–E) (Säljö, 1981). In this study, students' approaches to learning and studying were identified by using the ASSIST (short version) with 18 items.

RESEARCH QUESTION

The main question posed in this study was: How can students' approaches to learning be used and incorporated in teaching and assessment with the aid of PRS to improve the Mathematics pass rate?

SUB-QUESTIONS

To answer the main question of this study a number of sub-questions were asked relating to:

- What were students' approaches to learning Mathematics?
- How was students' performance when using PRS?
- What were students' perspectives towards the use of PRS in a mathematics course?

METHOD

The pragmatist philosophy was adopted in this study. It was adopted because pragmatists are allowed to nominate the approach and methodology most suitable for a specific research question, supplying a conceptual basis for the utilization of both quantitative and qualitative methodology (Goles & Hirschheim, 2002). In this case, pragmatism was applied in the sense of using a mixed method approach to understand the investigated problem. The basis of using this method was a combination of quantitative and qualitative approaches which gives a clearer understanding of research problems than a single approach (Hart, Smith, Swars, & Smith, 2009). The embedded experimental design was used. The embedded experimental design had three phases namely: preliminary data, intervention, and post intervention data. In the preliminary data phase, quantitative data relating to students' approaches to learning using *ASSIST* were collected. The aim of collecting this initial data was to develop an intervention. The intervention phase involved the implementation of a TETS using PRS. Here three PRS continuous assessments were completed. In the post intervention data phase qualitative and quantitative data were also collected by means of instruments used in the preliminary data phase. The ethical approval for using the students at this University of Technology was granted.

Participants

Participants were 240 students enrolled for Mathematics II at a study University of Technology in South Africa. These students comprised of two groups. Lecturers and students in these groups gave consent to participate in the study. The first group of participants were 49 students taking Chemistry. These participants were referred to as Mathematics II – Group A (MII – Group A) students. In the preliminary data phase the ASSIST questionnaire was completed and returned by 49 (100%) students. On the other hand, in the post-intervention data phase the ASSIST questionnaire was completed and returned by 36 (73.5%) students, while 13 (26.5) students did not participate. The WiHC questionnaire was completed and returned by 36 (73.5%) students in both phases.

The second group consisted of 191 students comprised of Electrical Engineering and Surveying students. This latter group was referred to as the Mathematics II – Group B (MII – Group B). The ASSIST questionnaire was completed and returned in the preliminary data phase by 177 (92.7%) students. Fourteen (7.3%) students did not participate in this research. On the other hand, in the post-intervention data phase 116 (60.7%) students completed and returned the ASSIST questionnaire, and 75 (39.3%) did not. The WiHC questionnaire was completed and returned by 176 (92.1%) students in the preliminary data phase and 117 (61.3%) students in the post-intervention data phase. This implies that 15 and 74 students respectively in each data phase did not participate.

Purposeful and convenience sampling were used to select the participants based on the qualitative assumptions. Purposeful sampling was selected, because it is typically incorporated in qualitative research. It is generally used to enhance the understanding of the information-rich cases probed, that is, it allows for an in-depth investigation in a study (McMillan & Schumacher, 2001; White, 2005). In this study, purposive sampling was used for the qualitative aspects of the data collection. A convenience sample of students was selected based on the fact that they were interested to participate and availed themselves after the researcher consultation with their lecturer. Simple random sampling was essential because each member of population is equally likely to be chosen as part of the sample in simple random sampling (Dudovskiy, 2018). On the other hand, simple random sampling were used to select the participants for quantitative aspects of the study.

In the first study group which was MII – Group A, in terms of sex, (54.3 %) did not disclose this information. With respect to their ages, 93.9% of the participants' ages ranged between 19 and 44 years (M = 23.8 years, SD = 4.8) so 3 did not indicate their ages. There were 24 (49.0%) participants who were registered for the very first time in this course. Also, 12 (24.5%) indicated that they had failed the course at least once while the rest (26.5%) did not disclose their registration status. In the second study group which was MII – Group B, in terms of sex, 108 (56.5%) were female and 45 (23.6%) male while the rest did not disclose this information. With respect to their ages, 87.4% of the participants' ages ranged between 18 and 35 years (M = 21.0 years, SD = 2.2) so 24 did not indicate their ages. There were 126 (66.0%) participants who were registered for the very first time in this course. Also, 49 (25.6%) indicated that they had failed the course at least once while rest (8.4%) did not disclose their registration status. Table 1 shows the biographical data of the participants in all the two study groups.

Table 1. Biographical data of the participants of the two study groups

		MII – Group A (n=49)		MII – Group B (n=191)	
		n	%	n	%
Sex	Female	24	49.0	108	56.5
	Male	22	44.9	45	23.6
	Not disclosed	3	6.1	38	19.9
Age	17–19	1	2.0	35	18.3
	20–24	31	63.2	125	65.4
	25 years of age and older	14	28.6	7	3.6
	Not disclosed	3	6.1	24	12.6
Registration	1st time	24	49.0	126	66.0
	2nd time	8	16.3	29	15.2
	3rd time or more	4	8.2	20	10.4
	Not disclosed	13	26.5	16	8.4

Instrument And Procedure

Table 2 shows the summary of data collection and analysis of the two study groups. Firstly, data were collected using ASSIST short version to identify students' approach to learning. Secondly, TETS with the aid of PRS was developed to create learning activities that accommodated various approaches to learning. In this regard, weekly PRS continuous assessments were used to collect data. Thirdly, to establish students' academic performance the semester test results were used. Finally, students' perspectives towards the use of PRS in a Mathematics course were examined using the survey questionnaire which included closed and open-ended questions. The qualitative data were analyzed using Atlas.ti and the quantitative data was analyzed using SPSS version 21.

Assist

The ASSIST – Short Version (see Appendix) is an 18-item inventory comprising of three subscales that measure Deep, Strategic and Surface approach (Entwistle et al., 2006; Simelane et al., 2011; Speth, Namuth, & Lee, 2007). Permission was granted by developers to use the instrument. In responding to the instrument, students were requested to indicate their choice on a 5-point Likert-type rating scale anchored by 1: Disagree and 5: Agree. The Deep approach refers to students who want to understand ideas on their own, relating ideas to previous knowledge and experience, looking for patterns and underlying principles. A typical example of an item from this 220 subscale was "When I'm working on a new topic, I try to see in my own mind how all the ideas fit together". The second subscale is the strategic approach. The typical example of an item from this subscale is "I organize my study time carefully to make the best use of it". The third subscale is the Surface approach. A typical example of an item from this subscale was "I'm not really sure what's important in lectures, so I try to get down all I can."

In terms of the reported reliability of scores obtained from the ASSIST – Short Version, in the USA, alpha values for the three subscales ranged between 0.65 and 0.75 (Speth et al., 2007). Specifically, the alpha values were: Deep approach ($\alpha = .65$), Strategic approach ($\alpha = .75$) and the Surface approach ($\alpha = .70$). In Hong Kong alpha values were found to be: Deep approach ($\alpha = 0.67$), Strategic approach ($\alpha = 0.73$) and the Surface approach ($\alpha = 0.59$) (Sadler-Smith & Tsang, 1998). On the other hand, in the UK these authors reported values of a Deep approach ($\alpha = .79$), Strategic approach ($\alpha = .82$) and the Surface approach ($\alpha = .79$) (Sadler-Smith & Tsang, 1998). In Hong Kong and UK the Revised Approaches to Studying Inventory (RASI) were used. With regards to the validity of scores from the ASSIST instrument, in this study, two statistical techniques were computed that were content and construct validity. Content validity was ascertained by determining the factor structure of this instrument using the values for Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. In both instances, the value of KMO was acceptable while Bartlett's test of sphericity was also statistically significant ($p < 0.001$). Construct validity was ascertained by computing a confirmatory factor analysis (CFA). The goodness of fit statistics were: Tucker-Lewis fit index (TLI) = .948, the Comparative fit index (CFI) = .947, and the Root mean squared error of approximation (RMSEA) = .054.

Table 2. Summary of data collection and analysis of the two study groups

Research question	Participants N = 240		Phase	Data collection instruments	Data analysis
	MII – Group A N = 49	MII – Group B N = 191			
What were students' approaches to learning mathematics?	49 (100%)	177 (92.7%)	Preliminary data phase	ASSIST	SPSS • Reliability • Validity Frequency distribution and %
What were students' perspectives towards the use of PRS in a mathematics course?	36 (73.5%)	176 (92.1%)	Preliminary data phase	WiHC questionnaire with open-ended and closed-ended questions	Atlas.ti
How was students' performance when using PRS	43 (87.6%)	191 (100%)	Intervention	PRS Continuous Assessment	Students PRS results
How was students' performance when after the use of PRS	36 (73.5%)	117 (61.3%)	Post-intervention data phase	Semester Test	Students results
What were students' perspectives towards the use of PRS in a mathematics course?	36 (73.5%)	117 (61.3%)	Post-intervention data phase	WiHC questionnaire with open-ended and closed-ended questions	Atlas.ti
What were students' approaches to learning mathematics?	36 (73.5%)	116 (60.7%)	Post intervention data phase	ASSIST	**SPSS** • Reliability • Validity Frequency distribution and %

PRS Continuous Assessment

The PRS was used with a rich and flexible teaching strategy known as TETS. The aim of TETS with the aid of PRS was to assist students to develop active learning and higher order learning (Simelane, et al., 2011). In this case, these assessments were meant to establish the effectiveness of the TETS. In each group, three weekly PRS continuous assessments (PCA) were conducted. The PCA for MII – Group B and MII – Group C comprised of five questions testing the knowledge of the application of differentiation (PCA-1), application of integration (PCA-2) and optimization (PCA-3). Figure 1 gives an example of questions from each PCA for MII.

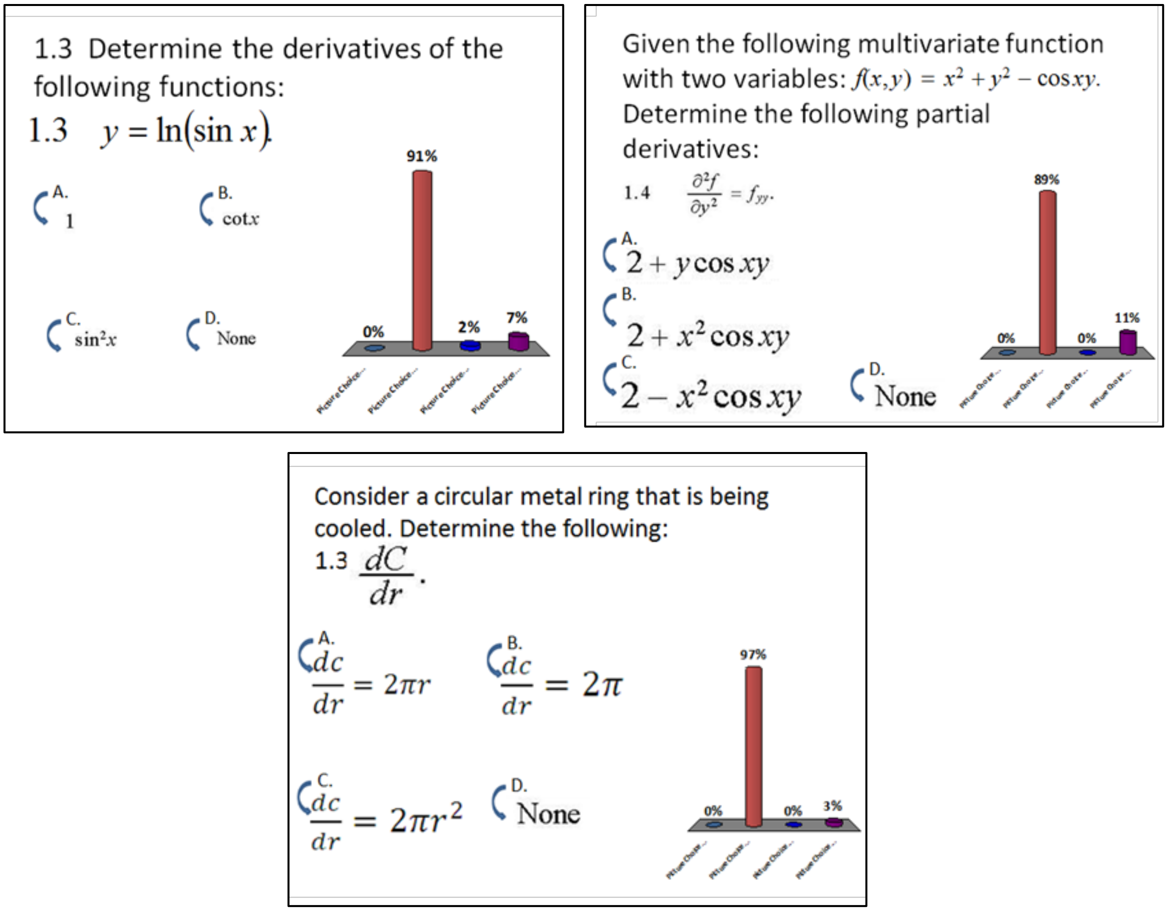

Figure 1. Examples from PCA 1, 2 and 3 for MII

Semester Test Results

The semester test was a scheduled test, written by all participating groups. The test was written during the second last week of the semester. From this test, the interest was only in students' marks for the purposes of this study.

What Is Happening In This Class

The "What is happening in this class" (WiHC) was the survey questionnaire developed by the researcher with open-ended and closed-ended questions. The WiHC was divided into three parts. In the first part, students were requested to provide demographic information such as gender and age. The second part was made up of closed questions. The closed questions covered issues related to teaching and learning. The part with closed questions had ten questions. Questions 5, 9, and 10 required students to provide information after the introduction of TETS using PRS. In Question 1, students responded to six questions where they were asked to register their views on a 3–point Likert-type rating scale anchored by 1 = all the time, 2 = about half the time and 3 = never. In this instance, the aim was to determine how things were done in class. For example, students had to rate the items such as Does the lecturer come prepared to class? In Section B, students were requested to rate the teaching media that were used in class. The aim was to identify the media that were mostly used during lectures. In Question 2, students were requested to indicate the timeframe at which they received answers to questions they asked in class. In this case, the aim was to determine how long it took for students to receive feedback on questions they had asked.

In Question 3, students were requested to indicate what action they took when there were concepts or anything they did not understand in class. Here the aim was to determine the action students took when they needed to understand something. In Question 4, which covered only the post-intervention data phase, students were requested to indicate their preferences about PRS. In this instance, the aim was to find out whether students wanted to own PRS or whether these belonged to the university. In Question 5, students were requested to provide information about assessment activities. The aim was to establish the types of assessment activities that they used in the course. In Question 6, students were requested to provide information about the methods of assessment used in mathematics. In contrast to Question 7, here the aim was to find out how the assessment was carried out from time to time. In Question 8, students were requested to indicate how long it took before they got their test results back. In Question 9, students were requested to indicate how the TETS using PRS was assessed. In Question 10, students were requested to indicate how long it took for them to receive feedback on PRS assessments.

In order to verify accuracy from a qualitative perspective, trustworthiness in this study was ascertained in two ways. The first involved, taking the instrument to colleagues and Mathematics lecturers in order to address issues of objectivity and credibility. The second entailed taking information back to the participants for them to verify if what was interpreted is what they meant.

RESULTS

ASSIST

The results are presented according to the research questions. ASSIT was used to answer the question: What were students' approaches to learning mathematics? Table 3 shows the results of students according to approaches to learning for each group. With respect to MII – Group A, all the students 49 (100%) completed and returned the questionnaire. The Z scores led to the classification that indicated that the approaches were similar across the board. For that reason, all three approaches were preferred by students. In MII – Group B, the ASSIST questionnaire was completed and returned by 177 (92.7%) students. Fourteen (7.3%) students did not participate in this research. The majority of the students were classified on the Strategic approach (35.1%) and this was closely followed by the Surface approach (31.9%). In this regard, the Strategic and Surface approaches were the most prevalent approaches see Table 3. The order of classification of students' approaches to learning was Strategic / Surface → Deep.

Table 3. Classification of students according to approaches to learning in respect of groups

Group	Deep	Strategic	Surface
		N (%)	
MII – Group A	17 (34.7)	16 (32.6)	16 (32.6)
MII – Group B	49 (25.7)	67 (35.1)	61 (31.9)

PRS CONTINUOUS ASSESSMENT

Both the groups (MII - Group A and MII - Group B) took the PCAs. The PCA was used to answer the question: How was students' performance when using PRS? It is worth pointing out that results are presented according to the number of students who indicated their approach to learning and took the PCAs. Table 4 shows the frequency distribution (%) of PCA 1, 2 and 3 by approaches to learning, sex as well as semester test results of MII - Group A. Out of the 49 students in this group, 6 (12.2%) did not write this assessment. Regarding PCA-1, it may be seen from Table 3 that 33 (76.7%) of students passed this assessment. The majority 13 (30.2%) were following the Surface approach and those who failed this test were10 (23.3%). PCA-2 was written by 39 out of 48 students Table 3 shows that 34 (87.2%) of the students passed this assessment. The majority of the students were following the Deep (13) approach and this was closely followed by the Strategic approach (12).

About 5(12.8%) of the students failed this test. In PCA-3, 38 out of 48 students wrote this assessment respectively. All of the students (100%) passed the assessment. The semester test was written by 43 (87.7%) students while 6 (12.2%) did not. Table 3 shows that a majority of students 29 (67.4%) passed the semester test. From those 11 (25.6%) were the following Strategic approach and this was closely followed by the Deep approach 10 (23.3%). The results also show that 14 (32.6%) students failed the semester test.

Table 4. The frequency distribution (%) of PCA 1, 2 and 3 by approaches to learning, sex as well as semester test results of MII - Group A

Approach to learning	Sex		No Sex	PCA-1 (n = 43)		PCA-2 (n = 39)		PCA-3 (n=38)		Semester test (n = 43)	
	Female	Male		Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail
Deep	9	7	1	11	3	13	-	13	-	10	4
Strategic	9	3	4	9	5	12	1	13	-	11	4
Surface	6	5	5	13	2	9	4	13	-	8	6

Semester test results were used to answer the question: How was students' performance after using PRS? All the students 191 in this group wrote the assessment. The results for MII - Group B are presented according to the number of students (145) who indicated their approach to learning and took the PCAs. Table 5 shows the frequency distribution (%) of PCA 1, 2 and 3 by approaches to learning, sex as well as semester test results of this group. The results reveal that 105 (72.4%) students passed PCA 1 and 40 (27.6%) students failed this assessment. Also in this group, the majority of the students who passed 41 (28.3%) followed the Surface approach and those who failed this assessment were9 (6.2%). PCA-2 was written by172 out of 191 students. The results show that 118 (81.4%) passed this assessment and 27 (18.6%) did not. In this case, the majority of the students followed a Strategic Approach 44 (30.3%). In PCA-3, about 120 (82.8%) students passed this assessment and 25 (17.2%) failed. In this assessment students 40 (27.6%) who followed the Strategic approach passed. The results show that the majority of the student 104 (71.7%) passed the semester test.

Table 5. The frequency distribution (%) of PCA 1, 2 and 3 by approaches to learning, sex as well as semester test results of group MII – Group B

Approach to learning	Sex		No Sex	PCA-1 (n = 145)		PCA-2 (n = 145)		PCA-3 (n = 145)		Semester test (n = 145)	
	Female	Male		Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail
Deep	24	14	-	29	8	32	6	31	6	28	8
Strategic	22	35	-	35	23	44	15	43	16	36	23
Surface	39	8	2	41	9	42	6	46	3	40	9

WiHC: Quantitative

The WiHC with open-ended and closed-ended questions was used to answer the question: What were students' perspectives towards the use of PRS in a mathematics course? This questionnaire assessing teaching and learning comprised of 9 questions. The WiHC questionnaire was completed and returned by 36 (73.5%) students in MII – Group A. This implies that 13 (26.5%) students did not participate. For MII – Group B the WiHC questionnaire was completed and returned by 117 (61.3%) students. This implies that 74 students did not participate. Table 6 shows students' ratings for teaching and learning for all groups. In Question 1, students were requested to indicate the media that were used during lectures. A combination of different media was reported to be used, the most reported media was the PRS (MII – Group B = 32 and MII – Group C = 97) followed by the whiteboard, data projector, the LMS e-IMFUNDO, Textbooks and Study guides. In Question 2, students were requested to indicate the timeframe at which they received answers to questions they asked in class. Students from all groups indicated that they received answers immediately during class. In Question 3, students were requested to indicate what action they took when there were concepts or anything they did not understand in class. Students from both groups indicated that they asked questions immediately. In Question 4, students were requested to indicate their preferences for PRS. Here the results show that the majority of the students between (56.4% - 77.8%) preferred to receive a PRS in class. In Question 5, students were requested to provide information about assessment activities that were conducted in a course. The results show that a combination of various assessment types was reported to be used the most reported assessment types were the continuous assessment followed by the post-test, assignment, semester and exam.

Table 6: Students' ratings for teaching and learning for all groups

	Item	1	2	3	1	2	3
		MII – Group A (N = 36)			MII – Group B (N = 117)		
1.	How often do you attend lectures?	33 (91.7)	3 (8.3)	-	107 (91.5)	8 (6.8)	2 (1.7)
2.	Does the lecturer come prepared to class	36 (100)	-	-	106 (90.6)	8 (6.8)	3 (2.6)
3.	How often do you participate in classroom activities?	21 (58.3)	10 (27.8)	5 (13.9)	64 (54.7)	48 (41.0)	5 (4.3)
4.	How often do you ask questions in class?	3 (8.3)	23 (63.9)	10 (27.8)	23 (19.7)	74 (63.2)	20 (17.1)
5.	Are you allowed to ask questions during the lecture?	11 (30.6)	17 (47.2)	8 (22.2)	47 (40.2)	51 (43.6)	19 (16.2)
6.	Do you receive individual attention from the lecturer?	17 (47.2)	15 (41.7)	4 (11.1)	76 (65.0)	35 (29.9)	6 (5.1)

In Question 6, students were requested to provide information about the assessment methods that were used in the Mathematics course they were taking. Students from all the groups revealed that the pen and paper was the dominant assessment method followed by PRS. In Question 7, students were requested to indicate the timeframe at which they got their tests results back from the lecturer. Students from all groups indicated that got their test results back from the lecturer immediately in class (41.5% - 55.7%). In Question 8, students were requested to indicate the assessment methods used in the integration of TETS using PRS. Students from all the groups rated the post-test as the most used form of assessment followed by continuous assessments and pre-test. That is, most students indicated that they were always tested after learning the content. In Question 9, students were requested to indicate when they received feedback on PRS assessments. The results show that the students from both the groups (MII – Group A=34 and MII – Group B=86) indicated that they received feedback on PRS assessments immediately.

WIHC: QUALITATIVE

The results of three qualitative questions of both the groups (MII – Group A and MII – Group B) are presented. In some instances, participants did not disclose certain information that was asked in the open-ended questionnaire. The hermeneutic unit named PRS Project was created. In Question 1, students were required to provide information about the kind of learning activities they participated in. The theme that emerged was mathematics learning activities. This theme consisted of six categories relating to *interactions; asking questions; technology; problem solving; and no participation*. Students felt that they appreciated the use of electronic media. With regard to technology, text phrases students used were *PRS*, *computer test*, *Derive 6* (a computer program) and *learning management system*. About technology, Menzi argued that: '*I did exercises using PRS.'* Also, students indicated that they helped others. In this instance, Thando said: '*I enjoy helping my friends if they struggle in solving problems*.' Some of the students revealed that they did not participate in class activities. In this regard, a typical statement provided by Moses was: '*I never participated in any of the activities*.

In Question 2, students were requested to provide information about receiving feedback on assessments. The theme assessment feedback emerged. This theme comprised seven categories relating to *receiving feedback about assessment; via technology; in class; receiving feedback after marking; from the lecturer; correction after test; and no assessments done yet.* Students indicated that they received marked tests. In this case, the common words they used were scripts and tests. About receiving feedback from a lecturer, Mohammed said: '*Our lecturer handed back the scripts and we discuss it*'. With regard to using technology, students revealed that they received feedback immediately after test in class. Jamel reported: '*With PRS feedback immediately but with pen and paper, feedback is less it is a week after the test or after marking*.' About discussing the problem categories related to *corrections, remedial work, memorandum* and *other students* emerged. Students mentioned that corrections were completed after receiving feedback in class. Vangile said: '*By knowing what percentage you got and also doing corrections on difficult questions*.' In the category about marks during class, students revealed that they received their grades in the class. A typical statement was provided by Koos who reported: '*I get marks written on the mark sheet*.' With respect to feedback immediately, students revealed that with PRS feedback was received immediately. Here a typical statement was provided by Lucas who said: '*I would like the lecturers to use PRS most of the time because it saves time and we get feedback immediately at that time*.'

Students found receiving feedback was exciting. Regarding this matter, George argued that: '*It is much interesting and good to receive feedback using PRS*.' Students also indicated that they were not sure about how feedback is received in mathematics. Figure 2 shows the network relating to the students' responses to about receiving feedback on assessments.

In Question 3, students were requested to indicate whether feedback enhanced or improved their learning. The theme feedback enhanced learning was created. This theme consisted three categories relating to *feedback on assessment enhance learning; assessment helps and feedback on assessment does not enhance learning*. Students felt that feedback assisted them to learn new innovations which enabled them to deal with problems better. In this case, a typical statement was provided by Felix who said: '*Yes …, it does enhance my learning and I get to learn new methods*.' Students did not view assessment feedback as a contributing factor that enhances learning. For instance about tests and examinations are difficult; students felt that tests on individual concepts were easier than when a number of concepts were tested. This is a view typically expressed by David too, who indicated: '*No …, assessments done in class are about simple concepts when compared to test and examination questions*.'

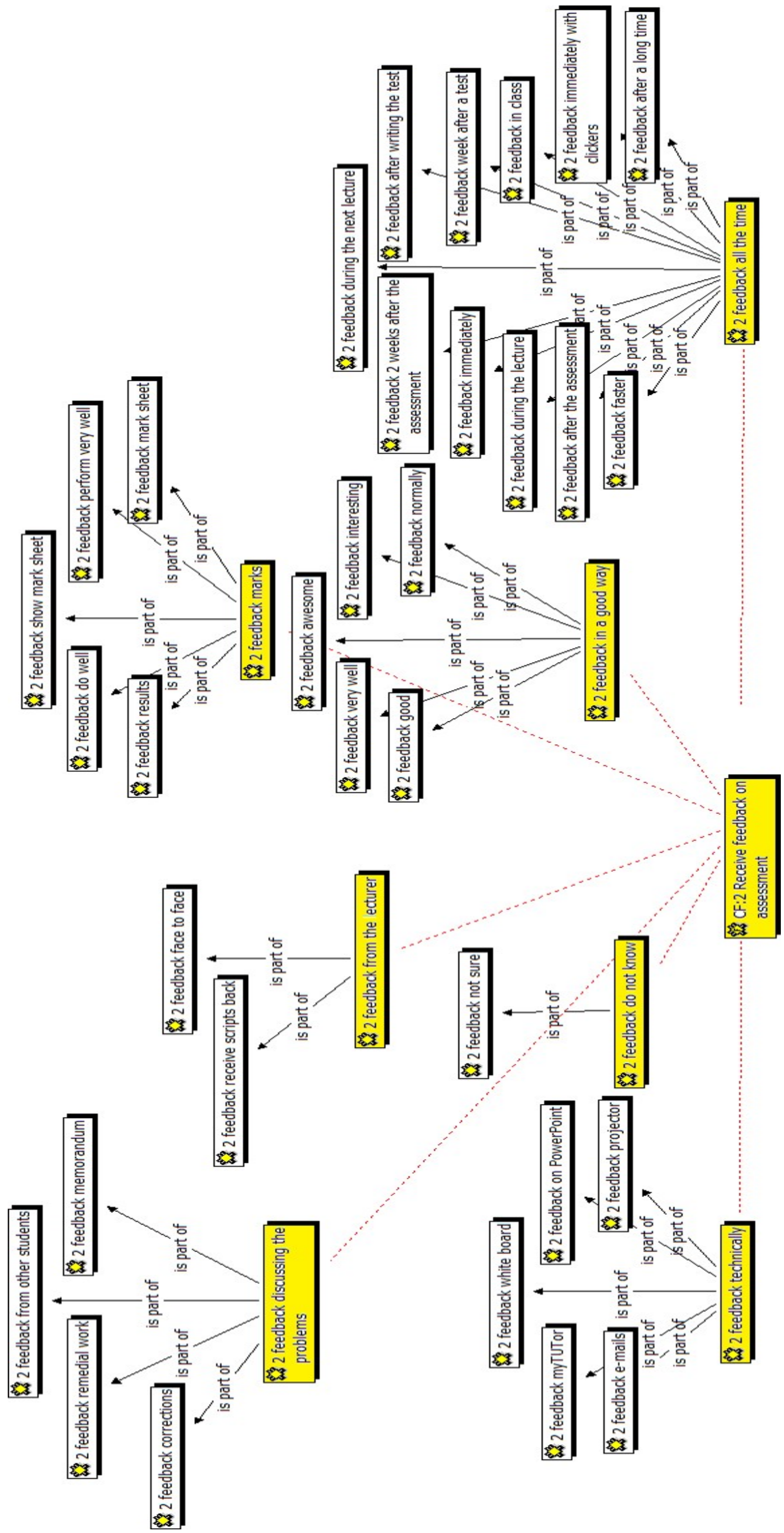

Figure 2. The network of receiving feedback on assessments

DISCUSSION

This study sought to answer the following question: How can students' approaches to learning be used and incorporated in teaching and assessment with the aid of PRS to improve the pass rate? To answer this question, qualitative and quantitative sub-questions were formulated. Before providing the answers it is worth mentioning the issues of reliability and validity of the scores from the ASSIST instrument used in this study are presented first. This is important because without ensuring reliability and validity it becomes difficult to accept a study's findings as credible.

The alpha values were computed for the scores from the ASSIST. In respect of this instrument, the alpha values were accepted for this study, because they were comparable to those reported in the literature (c.f. Entwistle 2006; Mnisi, 2015; Speth et al., 2007). With respect to the validity of the ASSIST, factor analysis (content validity) and confirmatory factor analysis (construct validity) were computed. Before computing the factor structure of the ASSIST, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were determined. The two values reported in this study indicated that computing the factor analysis was appropriate for the data (Field 2005; Mnisi, 2015). Using the Direct oblimin rotation consistently as in reported literature (c.f. Entwistle, 2006; Speth et al., 2007) a three-factor solution was accepted in this study. The three factors were Surface approaches (Factor 1); Deep approaches (Factor 2) and Strategic approaches (Factor 3). Because these factors were consistent with those reported in literature content validity was acceptable in this study.

To answer the question: What were students' approaches to learning mathematics? Students were categorized according to their prevalent approach to learning. These results revealed that the Strategic Approach was the most dominant among the participants. Literature points out that for those who follow the strategic approach, the aim is to achieve the highest possible marks through good time management and organized study methods (Entwistle, 2000). In fact, it is pointed out that learners following this approach study for success in assessments through effective use of space and time (Mattick et al., 2004). In consideration of this study's participants following Strategic approaches to learning, the TETS was constructed in such a way that it addressed them. In this instance more regular testing was introduced. The test results revealed an observable improvement in students' academic performance. Also, the number of students who passed increased.

Students were categorized according to their prevalent approach to learning. These results revealed that the Strategic Approach was the most dominant among the participants. The literature points out that for those who follow the Strategic approach, the aim is to achieve the highest possible marks through good time management and organized study methods (Entwistle, 2000). The major motivation in Strategic approach is achieving rather than ideas and interest (Deep approach) or fear of failure (Surface approach) (Diseth & Martinsen, 2003). In consideration of this study's participants following Strategic approaches to learning, the TETS was constructed in such a manner that it was directed to them. In this instance, more regular testing was introduced. The test results revealed an observable improvement in students' academic performance. Also, the number of students who passed increased. While the majority of the students followed the Strategic approach the same TETS was used for students following Surface Approaches. The same TETS was used because the researcher wanted to identify students following lower order learning approaches and assist them to improve their performance. Here the aim was to help them reach the level of Strategic approaches following students. This is consistent with the view that students following Surface approaches need to grasp the basic principles in order to work with complex principles (Mnisi, 2015).

With regard to students' performance when using PRS, it may be observed from the PCA1 results that students in MII - Group A were following the Surface approach and 23.3% failed this test. The literature states that students following the Strategic approach face the challenge in forming a bigger picture and aiming at reproducing the knowledge (Hailikari & Parpala, 2014). The aim of the TEST was to assist those students to adopt the high order thinking and critical skills in solving mathematical problems as well as adopt a Deep and Strategic approach to learning. In order to do this it was important to also develop the activities that cater for the Surface approach learners because it is reported that for students to work with complex principles or to apply Deep learning principles, they first need to try to grasp more basic principles, which require them to memorize and remember (Mnisi, 2015). In this regard, there was an improvement in PCA 2 as well as PCA3 where we observed students improvement in academic performance.

Concerning the question about students' performance after using PRS, it may be seen that the semester test results also increased. Also here we observed students adopting the Deep/Strategies approach and finally the majority of the students applied the Strategic approach to learning. In this case, it may be argued that in this study using PRS enhanced students' mathematical communication skills and helped to develop the skills needed to write as well as read mathematical proofs. PRS assessment activities have the ability to assist students to grasp the content. They strive to understand the mathematical content than to neither guess nor memorize the subject. These findings are supported by (Pisheh et al., 2019) when they revealed that PRS assist students to improve their critical thinking abilities.

With regard to students' perspectives towards the use of PRS in a mathematics course? Here, students were requested to indicate the media that were used during lectures. Participants identified two types of teaching media. These were traditional media and technology-enhanced media. The fact that traditional type media such as using chalk-and-talk is still prevalent in Mathematics lectures as identified by the participants is a cause for concern. This is because students may not be able to copy notes and diagrams from the board in good time. This situation may drive them to miss out on important aspects of a lecture and invariably not understanding what was taught during a lecture. In this regard, it is pointed out that educational theorists "… from Piaget, to Bruner to Zoltan Dienes … have underscored the fact that students learn best when allowed to actively participate in the formation of educational experiences" (Francis, 2013). This media in their lectures were not 'live interactive.' This was because the lecturer did not use the LMS e-IMFUNDO instead it was made accessible online and only after lectures. PRS were also included by the participants as another medium used in their lectures. However one has to remember that the PRS were introduced by the researcher and not by the lecturer in her day-to-day activities. One advantage of PRS was that all activities were 'live interactive' and promoted student engagement. This means that all interactions were within the lecture room and both the lecturer and the students used the PRS at the same time. The interactions PRS enable were important because they allowed for learning to be more authentic as well as promote the active participation and involvement of students (Farag & Park, 2015; Simelane, 2008a; 2008b). It is worth indicating that with the current technologies the 'live interactive' can also be achieved outside the class using apps and latest polling technologies to promote student engagement with the lecturer anywhere and at any time (Chan & Ko, 2019).

It may be seen from the results that students participated in various learning activities that promoted engagement, participation and interaction. In case it was found that the PRS helped increase interactions in the learning and teaching context. This suggests that there may be a correlation between interactions in the learning and teaching context and positive learning experiences students reported about using PRS. Regarding interactions, it has been opined that peer discussions for instance tend to be central when PRS are used and in most instances students engage actively in the learning process (O'Donoghue & O'Steen, 2007; Sprague & Dahl, 2010). In many ways students believed that the integration of PRS helped them to learn better (Reay, Li, & Bao, 2008) and promoted student-student and student-lecturer engagements (Mnisi, 2015).

With respect to students 'perceptions about receiving feedback on assessments when using PRS, it may argued that the utility of PRS was in the fact that they provided immediate feedback. Students felt that immediate feedback helped them to improve the understanding of concepts, identify their mistakes as well as think deeply about a particular problem. This view is supported in the literature (Chan & Ko, 2019; Pisheh et al., 2019). Simelane et al. (2011) argue that the regular use of PRS encourages students to think deeply during the learning process and reduces guessing and memorizing among students. It was interesting that students identified the PRS' advantage of providing immediate results.

Students manage their learning time because PRS allowed them to be confident in the subject because different activities yielded immediate results. It may be argued that students in the class attended lecturers most of the time. Students also indicated that lecturer comes prepared to class. It may be seen from the result that most of the students' participated in classroom activities. Because of the PRS that was used in class, it allows all the students to respond to a single question. Most of the students were able to identify their mistake and rectify them. In this regard, the results showed that the majority of students asked questions halfway through the period. The majority of the students learnt to work on their own in solving mathematical problems hence most of them indicated that about half a time they will ask the question during the lecture. Students' responses here were consistent with the view that when PRS are used in class; students pay attention to the posed question and respond favorably to these (Solomon et al., 2018). It may be argued that in this study, the lecturer adopted to teach by questioning strategy in class (Simelane-Mnisi & Mji, 2017a). This was interesting because it is pointed out that immediate feedback allows lecturers to align the delivery of content and to teach by the method of questions (Mnisi, 2015). Most of the students felt that using PRS in class allowed individual attention from the lecturer (Solomon et al., 2018).

CONCLUSION

In conclusion, this study attempted to provide answers to the use and the incorporation of students' approaches to learning in teaching and assessment with the aid of PRS to improve the pass rate. We observed in this study that the Strategic Approach was the most dominant among the participants.

The TETS was created based on them. We also seen that the activities that were used with TETS also accommodate the Surface and the Deep Approach. The aim was not to leave any behind but involve all the students in the learning process and to promote cooperative learning. The same TETS was used because the researcher wanted to identify students following lower order learning approaches and assist them to achieve. Here the aim was to help them reach the level of Strategic approaches following students. We also observed how TETS was used with PCA to support the Surface approach students who were under performing to adopt the high order thinking and critical skills in solving mathematical problems. This enable the Surface approach learners to adopt a Deep and Strategic approach to learning. Semester test results indicated that using PRS enhance students' mathematical communication skills to read mathematical proofs. The use of PRS learning activities in the Mathematics course promoted engagement, participation and interaction amongst the students. Also the immediate feedback provided by the RRS assisted the students to understand of concepts, think deeply about a particular problem and identify and correct their mistakes when solving mathematical problems.

RECOMMENDATION

It is recommended that academics take into consideration the students' approaches to learning in their teaching practices. It is crucial that lecturers take advantage of technology to enhance their teaching practices and decrease the fear of the unknown and open up to new innovations in teaching. It is important that the institution of higher learning integrate as well as support the educational technology innovations to teaching and curricula. It is crucial that the use of PRS be explored in different mathematics settings (different lectures and universities). Such an exploration the researcher feels will be useful in endorsing what has been reported in this paper. It is critical that a further study is conducted with students in different disciplines where poor academic performance is experienced.

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APPENDIX

Approaches and Study Skills Inventory for Students (ASSIST - Short Version)

1	I often have trouble in making sense of the things I have to remember.	5	4	3	2	1
2	When I'm reading the article or book, I try to find out for myself exactly what the author means.	5	4	3	2	1
3	I organize my study time to make best use of it.	5	4	3	2	1
4	There's not much of work here I find interesting or relevant.	5	4	3	2	1
5	I work steadily through the term or semester, rather than leave it all until the last minute.	5	4	3	2	1
6	Before tackling a problem or assignment, I first try to work out what lies behind it.	5	4	3	2	1
7	I'm pretty good at getting down to work whenever I need to.	5	4	3	2	1
8	Much of what I'm studying make little sense: it's like unrelated bits of pieces.	5	4	3	2	1
9	I put a lot of effort into studying because I'm determined to do well.	5	4	3	2	1
10	When I'm working on the new topic, I try to see in my own mind how all ideas fit together.	5	4	3	2	1
11	I don't find it all difficult to motivate myself.	5	4	3	2	1
12	Often I find myself questioning things I hear in lectures or read in books.	5	4	3	2	1
13	I think I'm quite systematic and organized when it comes to revising for exams.	5	4	3	2	1
14	Often I feel I'm drowning in the sheer amount of material we're having to cope with.	5	4	3	2	1
15	Ideas in course book or articles often set me off on long chains of thoughts of my own.	5	4	3	2	1
16	I'm not really sure what's important in lectures, so I try to get down all I can.	5	4	3	2	1
17	When I read, I examine the details carefully to see how they fit in with what's being said.	5	4	3	2	1
18	I often worry about whether I will ever be able to cope with work properly.	5	4	3	2	1

BIOGRAPHIES

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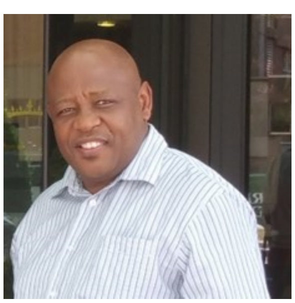

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