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Learning Mathematics through WhatsApp Groups in University Preparatory Program during the COVID-19 Pandemic

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ABSTRACT

This study investigates the effects of WhatsApp social media learning group in the teaching and learning of mathematics with first year underprepared university students. The study was undertaken using a quantitative research method. It employed a randomised post-test-only with a non-equivalent groups design to investigate if there is a statistically significant difference between university students who studied through the traditional face-to-face lecturing approach and students who utilised a blended approach to learning mathematics. The study population comprised first-year university students enrolled for the university extended programme offered by all universities in South Africa. The sample consisted of 192 experimental groups and 341 control group students conveniently sampled from a university in South Africa. The main instruments used in this study were two standardised semester exams. These tests were checked and moderated by senior mathematics lecturers to ensure they conformed with the module content and satisfied all assessment policies of the university. The Cronbach alpha coefficient was used to measure the consistencies in these two-semester exams. The study's main finding showed no statistically significant difference in results between students who studied mathematics through a face-to-face lecturing approach and students who studied mathematics through a blended learning approach. The study concludes that the latter performed slightly better than students in the former, confirming that a WhatsApp learning group can be a viable alternative to the teaching and learning at the university when face-to-face learning is not possible, as for an example in the Covid-19 era. The study recommends that more profound research be conducted to identify and analyse positive indicators when learning is done through social media interaction.

KEYWORDS

Learning mathematics; social media; WhatsApp learning group; mathematics achievement.

INTRODUCTION AND BACKGROUND

The transition from the primary education system to the higher education system has never been smooth for under-prepared students, with unconvincing results emanating from the primary school system. Our experience with these types of students as researchers indicates a considerable mathematics knowledge gap between their high school mathematics and first-year university mathematics, making the university preparatory program a critical lifeline for students' success in the university system.

Wolmarans et al. (2010) define the mathematical knowledge gap as the difference between the knowledge possessed by school leavers and the knowledge required for first-year entry into mathematics courses. Most first-year university students even find it difficult to cope with mathematics bridging courses. Some have to repeat the procedure for a few years before they are considered competent for the program. The Department of Higher Education estimated the annual drop-out rate in South African universities in 2012 to be 35% (DHET, 2013). The Council for Higher Education in 2013 went further to explain that only 25% of students in residential universities graduated within the minimum turnaround time required, and only 35% of the total number of students enrolling in any given year obtain their degrees within five years (CHE, 2013). A report by DHET (2013) cites, among the various reasons, insufficient support for hugely underprepared first-year university students who experienced poor standards of teaching and learning at the primary school level. Help is needed to avert the high student failure rate in the higher education sector.

For this reason, these students are typically placed in university preparatory programs that involve mathematics pre-requisites to strengthen their understanding of the basic mathematical concepts and integrate basic high school mathematics concepts with introductory university mathematics concepts. Universities in South Africa attempt to address the poor quality of teaching and learning among students of previously disadvantaged backgrounds only after students have entered higher education (Lombard, 2020). This preparatory mathematics course is designed to run for 6 hours a week in a face-to-face lecture mode. It is a smooth transition medium to gradually introduce fresh first-year Mathematics students (with average mathematics results from the primary school system) to university mathematics.

Problem Statement

This study investigated whether or not learning Mathematics through WhatsApp learning groups impacted the mathematics performance of first-year university students engaged in a university's extended program. The emergence of covid-19 necessitated the reduction of contact, face-to-face sessions to limit the impact of infection. This gave rise to institutions and lecturers, particularly exploring other teaching and learning methods and involving the online learning space where social media could become a valuable resource in the learning process. This study, therefore, investigated the impact on students' mathematics achievements when

social media was explored as a supportive learning tool compared to students who studied the module merely through face-to-face interaction in the lecture venues.

Research Question

What impact does social media (WhatsApp), as a learning platform, have on first-year university students' preparatory mathematics performance?

Aim of the Study

The study aimed to determine whether or not there was a statistically significant difference in first-year mathematics results for first-year university preparatory students who learnt through a traditional face-to-face approach and students who learnt through a blended process of face-to-face and social media learning platforms.

A null and alternative hypothesis was formulated as follows:

- H_0: There is no statistically significant difference in the average score of two-semester exams between the control and experimental groups.
- H_1: There is a statistically significant difference in the average score of two-semester exams between the control and experimental groups.

Theoretical Literature Framework

The theoretical framework that informed the current study was social constructivism. Gergen (1973 cited in Passer & Smith, 2008) explains that in social constructivism, individuals learn from a group and, in doing so, can gel with the learning style of the group whiles maintaining their way of learning (Gergen, 1973 as cited in Passer & Smith, 2008). It also reveals and explains how knowledge transfer can take place through lecturer-student interaction and student-student interaction. The idea of social constructivism was coined to enable literature to understand the mental processes that are involved in allowing the students to conceive ideas on how to deal with complex problems and how students can develop unique strategies to deal with complex problems and in the process forming unique problem-solving strategies, this according to Passer and Smith (2008) is produced from a shared way of thinking within social settings. Vygotsky (1978) further explains that cognitive development in students stems from social interaction from guided learning within the zone of proximal development as students and their peers' co-construct knowledge in a social setting.

Social constructivism in the current study guides how students can acquire and share mathematical knowledge while learning mathematics through using a social setting on a WhatsApp platform group. The theory will also help the researcher understand the reasoning of students' use of social media (WhatsApp) for effective teaching and learning of mathematics in their program through student-student interaction or student-lecturer interaction.

Amry (2014), after comparing students who learnt mathematics through WhatsApp group chats where mathematical knowledge was constructed through social constructivism compared to students who learnt mathematics through traditional face to face approach, concluded that the former performed better than the latter. Then there was a real difference in

the mathematics scores between the two groups. Gasaymeh (2017) also reported that students have a positive feeling towards integrating WhatsApp into their formal learning.

Learning is a process of thinking whereby the mind can conceive of myths that discourage or encourage students to use a particular concept or concept for solving problems effectively through social media. In problem-solving situations, under certain mathematical constructs called schemas, the mind reasons how to execute an action through commitment in practice. Schemas are mechanisms in human memory which allow for the encoding, synthesis, generalisation and retrieval of experience similarities (Marshall, 1995) to execute familiar different cases or problems action.

Learning mathematics is purely a constructive process because it is cumulative, and mathematical concepts are interrelated (Ncube, 2013). Learning that focuses on practical activities and students-frequent use of social media can pave the way for sharing ideas through social interaction. Piaget (1968) contends that learning takes place in three phases: (1) Assimilation, putting new data into schemas; (2) Accommodation, converting existing schemas into new knowledge and (3) Equilibration: finding a balance between oneself and the world through sharing of ideas using any effective medium (such as social media). The Higher education curriculum is currently structured to include the subject content and the didactics aspects in the same module. Therefore, teaching and learning must be done so that students enjoy the lecture and contribute through their participation.

A significant set of ideas of constructivism is that knowledge comes from the foundation of experience through social interaction; hence, students' use of social media such as WhatsApp will help them understand Mathematical concepts taught by their lecturers in a program. The understanding of the world is impacted mainly by social experiences, and individuals have specific knowledge that emanates from unique backgrounds. Nonetheless, the bulk of knowledge is socially shared from socially shared experiences. Therefore, all knowledge is social knowledge (Morgan, 2014). According to Goldkuhl (2012), Constructivism ideology helps manage people's existence and operations in the world hence the use of constructivist theory in this study.

Social Media and its Impact as a teaching and learning tool.

Social media network has become very popular among the youth, especially university students (Stephens, 2011; Stollak et al., 2011; Waters & Hensley, 2020). According to Stollak et al. (2011), social media is becoming the primary means of communication among university students. They estimate that at least 85 per cent of students enrolled in the university use social media as a means of communication. Stephens (2011) also explains that students in this current generation heavily rely on social media to communicate with one another.

With this situation in mind, many instructors have now started using social media networks to communicate and deliver learning materials to their students (Watson, 2020;

White, 2020). Albalaw (2017) reports that technology developed from the internet has become widely used as a medium for teaching and learning.

But some researchers have reported conflicting reports on the impact of social media in the teaching and learning process (Hoffman, 2009; Hsueh, 2011). Hoffman (2009) explains that using technology developed from the internet has the potential to improve student engagement, 'motivation, personal interaction, and affective aspects in the lecture room, but explains that this can only be achieved if there is careful planning with regards to its affordability and usefulness to the teaching and learning process. Hoffman further explains that the social media technology in the classroom can be a failure if its integration into the teaching and learning process is not well planned and executed. Hsueh (2011) shares similar sentiments with Nuraini et al. (2020) and reports that even though the use of social media can provide a rich teaching-learning experience to students, the viability of using it as a teaching and learning tool is still very limited in most universities and its introduction can automatically leave some students out of the teaching and learning process.

The current study explores the impact of social media on first-year students' mathematics performance with the extended university program. WhatsApp social media was adopted for this study as it is widely used and can be used specifically on mobile devices to which most students have access. University students' use of mobile phones has increased over the years (Benjamin, 2011; Porter et al., 2015). Mobile phones as a teaching tool can be beneficial for both lecturers and students. It has 'modern' and automated techniques for achieving teaching and learning goals (Boyle, 2013), and mobile phones are much cheaper to invest in than larger devices (Albalaw, 2017).

WhatsApp messaging social media can be downloaded, installed, and used on Android, IOS, and KIOS devices, all available on mobile devices. It can also be used on both desktops and laptops by pairing your mobile device with the desktop or laptop by scanning the QR-code, making a mobile phone a pre-requisite for using WhatsApp Technologies (Colom, 2021). Echeverría et al. (2011) explain that mobile media messaging technologies like WhatsApp has the potential to offer multiple teaching and learning options at the university and basic school level but remains an untapped potential at that level which, according to Rambe and Ng'ambi (2012), is due to a limited academic understanding and conceptualisation of how this technology can be integrated into mainstream classroom practice and uncertainties on educational outcomes if these technological advancements are introduced.

In their work, Naidoo and Kopung (2016) tried to find out how WhatsApp instant messaging influences mathematics learning and what its use entails. Naidoo and Kopung (2016), WhatsApp instant messaging offered students the opportunity to learn from anywhere and became a resource for students to clear out any misconceptions they may have about a particular mathematics concept. They also discovered WhatsApp instant messaging had limited the number of characters and symbols that students can use to express themselves mathematically. Nuiraini et al. (2020) confirm the findings of Naidoo and Kopung (2016)

revealed that in as much as WhatsApp instant messaging can help students to gain and learn new mathematics knowledge as it aids interaction with their peers, it has got some disadvantages when introduced into the learning process such as does not have a feature where students can type mathematics symbols and hence hindering students' participation in the teaching and learning process on the WhatsApp platform. The current study hopes to add further information to the literature on how WhatsApp instant messaging can improve the teaching and learning of mathematics for underprepared students at the university level.

RESEARCH METHODOLOGY AND DESIGN

This study followed a quantitative research design which employed a post-test only with non–equivalent groups to test whether there were any statistically significant results in the post-tests mathematics scores for first-year university preparatory students who studied the extended introductory mathematics module through a face-to-face approach (control group) compared with first-year university initial students who studied the same module through a combined blended approach (face-to-face, online, WhatsApp, social media interaction), this being the experimental group.

Quantitative research design uses numeric values to determine whether the null hypothesis should be accepted or rejected (Ary et al., 2010). With this design, the study used an independent t-test and descriptive statistics of both the control and experimental groups to measure students' mathematics performance when WhatsApp Chat groups are used as a teaching and learning aid and blended with the traditional methods faced face teaching approach. Descriptive statistics were used to understand whether Online WhatsApp Group Chat can be an alternative teaching method when face to face instruction is not feasible. The independent t-test was used to determine whether there were any statistically significant results between the control and experimental groups.

With this research design, the control group received different treatment from the experimental group but with both groups writing a similar post-test after the therapy (Creswell, 2003).

Description of Pre-Covid 19 face to the face learning approach

All lessons in this form of lecturer-student interaction took place in a traditional, face-to-face lecture room, where the lecturer passively delivered content to the students. A sit-down, the face-to-face test was conducted after every mathematical concept had been completed. There were also two face-to-face, sit-down semester exams that were performed. The first face-to-face semester exam was conducted halfway through the course. The second face-to-face semester exam was conducted when the content in the module was completed, with the focus being on the other half of the module content. The first-semester exam covered the first half of the module content, while the second-semester exam covered the second half. An average of the two tests was used to investigate the problem.

Description of a Post-Covid 19 Blended Learning Approach entailed a Hybrid of Face-to-Face and a Social Media Network Learning Approach.

The blended approach was designed to reduce face-to-face contact sessions at the time of the emergence of Covid-19, which could spread in crowded places where each person was close to others. Out of 6 hours in a week, only two hours were for a face-to-face contact session, and the rest of the 4 hours were spread through the week as a WhatsApp discussion which was held asynchronously, where the key concepts discussed on the face-to-face session was merely reinforced through social interaction on WhatsApp group chats. All concepts discussed and explained on the platforms were explained briefly during the face-to-face interaction to solidify students' deep conceptual understanding. Online tests replaced the sit-down, face-to-face test after completing each mathematical concept, and the two sit-down examinations were maintained as in the face-to-face learning approach.

Population and Sampling

The study population was all first-year university students in South Africa enrolled for an extended mathematics preparatory program. A convenient sampling technique was used to sample 533 first-year students from one university, of which 192 students formed the experimental group and 341 students formed the control group. This sample used the convenient sampling technique as the data were readily accessible. Suitable sampling procedures use available cases for a study (Ary et al., 2010).

Data Collection and Procedures

The control group only had face-to-face sessions, and their data were collected in 2019. The face-to-face sessions were held between March 2019 and June 2019. The first-semester exam was written in April 2019, and the second-semester exam was reported in May 2019. All lectures were purely face-to-face, with the lecturer passively delivering the lecture material. The experimental group had their classes partly face-to-face and partly using WhatsApp learning group interaction asynchronously delivered. The blended approach happened between March 2021 and May 2021, with first and second semester exams administered in April 2021 and June 2021, respectively. Each mathematical concept in the module began with face-to-face interaction that was passively delivered by the lecturer and continued thorough asynchronous WhatsApp group discussions where peer teaching, with the guidance of the lecturer, formed the basis of the teaching and learning.

The average of the two-semester exams was calculated for both the control and experimental group and compared to check whether there were any statistically significant results in the two average scores.

Validity and Reliability of Research Instruments

Two standardised exams used to examine students in the module were randomly chosen as the instruments for this study. The marks for the two examinations were converted to 100 per cent. The first standardised exams followed questions from the first half of the module, and the

second standardised exam catered for the second half of the module. Both of the two standardised tests had been thoroughly checked and moderated by senior mathematics lecturers from the universities to ensure they covered the contents in the module and conformed to all universities' assessment policies.

Previous results obtained in these two-semester examinations were used to check for consistency in the test. The Cronbach alpha coefficient was used to measure the consistency in the test that stood at 0.62 and 0.67 for the standardised exam one and standardised exam two, respectively.

Data Analysis

At 0.05 significance level, an independent t-test was employed to determine whether or not there were statistically significant differences between the first-year university students who studied first-year preparatory mathematics through a purely face-to-face approach compared to first-year university students who studied first-year preparatory mathematics through a blended approach of face-to-face interaction and online social media interaction. The mean, median, mode and standard deviation of the experimental and control groups were also calculated.

SPSS statistical software was used to calculate both the descriptive and the inferential statistics. The descriptive statistics compared the mean and standard deviation to ascertain which of the two groups performed better in the average of the two-semester exams conducted between the two groups (experimental and control) to determine which group performed better, and the inferential statistics were used to check whether the null hypothesis should be accepted or rejected.

RESULTS AND DISCUSSION

Table 1 shows the mean score for the control group was 48,84 and the average score for the experimental group was 49,57 showing the difference in scores between the control scores and the experimental group is minimal. There was not much difference in the performance of the average scores of the two-semester test between the two groups. This was also confirmed by the other central tendencies of the median and the mode. The median and method for the control group were 49.50 and 48,50 respectively, the median and mode were 50,49 and 65,59. The t-test analysis of the score between the control group and the experimental group indicated that at 0.05 significance level and at 531 degrees of freedom, the t-statistic value ($t_{(0.05,531)}$=0.6193) was less than the t- critical value (1.9644); the p-value (0.5360) was greater than 0.05 ($p > 0.05$). This meant the null hypothesis could not be rejected; hence there was not a statistically significant result in the average of two-semester examinations between first-year university students who enrolled in a university preparatory mathematics program and studied through a purely face-to-face approach compared to students who studied the same program through a blended approach of face to face and online social media interaction.

Table 1. Summary of the descriptive and inferential statistics

		Control Group(Average score of two-semester exams)	**Experimental Group(Average Scores of two-semester exams)**	
	Mean	48,84	49,57	
	Median	49,50	50,49	
	Mode	48,50	65,69	
	Std Dev	11,42	15,65	
	Observation	341	192	
Degrees of Freedom	531			
t - Statistic	0.6193			
t – Critical two-tail	1.9644			
p-value	0.5360			

This result suggests that even though there were no statistically significant results between the control group and the experimental group, online WhatsApp chat teaching groups can be a viable teaching medium and can be an alternative when face-to-face teaching instruction is not possible.

The findings were consistent with the work of Barhoumi (2015), So (2016), Nirgude and Naik (2017), Kushwaha and Jhawar (2018), and Jere et al. (2019). To mention only a few. Barhoumi (2015) confirmed the impact of WhatsApp group-learning groups when blended with a face-to-face approach. According to Barhoumi (2015), WhatsApp chat groups can be used as a supporting tool during class discussions which form part of the teaching and learning process. So (2016) also used the WhatsApp group as an intervention to the teaching and learning process and concluded that the WhatsApp group as a learning tool could make students achieve more academically. Nirgude and Naik (2017) found that WhatsApp group chat activity can be very effective for after class activity such as 'sharing information, assessment, discussions, feedback, and flipped classroom concept'.

The work of Kushwaha and Jhawar (2018) also supports the findings of this study in the sense that, according to them, if WhatsApp instant messaging is appropriately repurposed among university students, it can enhance their learning capabilities. They further explained that WhatsApp instant messaging, as a tool, can foster social constructivism by offering learners the platform to construct Mathematical knowledge in a social environment. Jere et al. (2019) also concluded that WhatsApp as a learning tool has the potential to make students active

participants in the learning process and, in the process, improve their performance in the subject.

CONCLUDING REMARKS

Even though there was no statistically significant difference between a strictly face-to-face learning approach and a hybrid of face-to-face and online approaches, the results show that the latter is just as effective as the former, with the learners in the latter performing slightly better compared with learners in the former. The results obtained from the quantitative analyses show that under-prepared, first-year university students can construct, acquire and transfer knowledge among themselves in a social context on an online WhatsApp group platform. This infers that WhatsApp, which is popular among underprepared first-year students, we can be categorised as the Z generation (students born after 1996), has the potential to become a viable alternative to teaching and learning when there is a situation that does not make it conducive to implementing the face-to-face, traditional teaching approach. Policymakers for higher education may have to look at formalising WhatsApp as an additional support mechanism to supplement traditional, face-to-face instruction; it may go a long way in supporting underprepared university students to gradually become successful in the university setting.
This study recommends that more profound research be conducted to develop social media interaction as a supplementary and alternative learning approach when a face-to-face approach is not viable.

The findings of this study go a long way to show that social media, which is popular among students of this generation, can become a viable alternative to teaching and learning when a face-to-face learning approach cannot be implemented.

Recommendation

This study recommends further more profound research to be conducted on how social media can be used as an alternative teaching platform during devastating times like the Covid-19 era. Qualitative analyses should now be considered to identify and analyse indicators that contribute positively to learning through social media learning groups.

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