RESEARCH ARTICLE

EFFECTIVENESS OF WHATSAPP VERSATILITY IN TEACHING MATHEMATICS AND SCIENCE PEDAGOGICAL SKILLS IN LARGE UNDERGRADUATE CLASSES AT THE UNIVERSITY LEVEL IN KENYA

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Abstract

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Universities in Kenya, like many others in sub-Saharan Africa, face challenges due to the rapid increase in student enrollment, leading to large class sizes due to insufficient funding. Numerous studies highlight the drawbacks of large classes and advocate for smaller class sizes to ensure quality education, particularly in science and mathematics. Therefore, finding effective and innovative methods to address the challenges of teaching large classes critical pedagogical skills of preparing schemes of work, lesson planning and improvisation in science and mathematics, is crucial for achieving quality education for university-level pre-service teachers. WhatsApp is an innovative videoconferencing tool that can facilitate instant sharing, group discussions, images, videos, video recordings, photographs, documents, web links, and lecture notes, all of which are effective for teacher training. This study aimed to explore the possibility of using WhatsApp to teach pedagogical skills to large university classes. A mixed-methods approach was utilized, with qualitative data analyzed through thematic content analysis, and quantitative data examined using frequencies and percentages. Conducted as classroom research, the study data was gathered via Google Forms questionnaires and Focus Group Discussions (FGDs), involving 120 third-year students studying pedagogy in STEM subjects. This study contributes by outlining strategies for using WhatsApp to address the challenges universities face in effectively teaching pedagogical skills and enhancing student engagement in large classes. The findings suggest that WhatsApp's flexibility supports easy information sharing, promotes collaboration, extends learning opportunities, and helps manage large classes more efficiently.

Keywords: Versatility, WhatsApp, STEM, Pedagogical Skills, Social Media

Introduction:-

The rapid growth of the educational sector in low-income countries of Africa, Asia and Latin America has raised concerns among stakeholders (Tristan, 2018). This is demonstrated by poor physical infrastructure, classrooms with large numbers of learners, old-fashioned curricula frameworks, poorly trained teachers with very low morale, and sometimes taking multiple uncoordinated roles at schools (Altbach et al. 2009; Salmi 1992; Tilak 2013). Graduates joining the teaching profession lack basic teaching skills and this has caused widespread dissatisfaction with the products of higher education in many developing countries (Tristan, 2018). Marginson (2016), notes that rapid growth of university is determined by several reasons. First, governments have been striving to meet the increasing demand for university slots, fueled by more students completing secondary school and families hoping for better social status through the acquisition of education skills (Marginson, 2016). Additionally, in today's knowledge-driven economy, there's a stronger focus on higher education as a means to boost national competitiveness and develop the advanced skills needed in various fields (Bloom et al., 2006). The private sector, particularly the for-as-profit segment, has also played a significant role, with educational institutions becoming attractive investments for businesses, leading to even faster growth (Kinser et al., 2010). On another note, the use of WhatsApp in education offers a valuable tool to enhance learning quality, as its ability to share visuals like pictures and videos makes it easier for students to grasp and visualize complex ideas.

Some factors have led to the rapid expansion. First, governments have been responding to the pressure of popular demand for higher education places, particularly in light of increasing secondary completion rates, and family desires for upward mobility (Marginson, 2016). Second, drives for national economic competitiveness in the context of the knowledge economy have led to an increasing value placed on higher education, and the need to develop high-level skills in particular areas (Bloom et al. 2006). Third, the liberalisation of the private sector – particularly the for-profit segment – has led to accelerated growth through the market's attractiveness to business investors (Kinser et al., 2010). The use of WhatsApp to mitigate against low quality also has the advantage of using visuals like pictures and videos which assists students to understand and conceptualise an idea vividly.

The Future of Learning:-

Due to the COVID-19 pandemic, educational institutions globally resorted to distance learning to keep students engaged, highlighting that online learning is the future of education (COL, 2024). With the rapid technological advancements, accessing quality education through online platforms has become easier for teachers and students. Over the years, learning has progressed significantly; traditional classrooms have relied on face-to-face teaching. Later, educators began using technology to support these in-person sessions, such as projectors and computers (Al-Mothanna, 2017; COL, 2024). Today, blended combines both face-to-face and online elements, allowing students can access materials remotely. Some courses are usually offered entirely online, with in-person interaction with the instructor, a method known as distance learning.

Online learning runs on several platforms including Learning Management Systems, Student Management Systems, and Video Conferencing Platforms (Commonwealth of Learning COL,

2024). Al-Mothanna (2017) found that the use of WhatsApp is mostly personal and social, however, application of WhatsApp in education was limited. The study found that participants perceived the integration of WhatsApp into their education to be easy, fun, and useful (Al-Mothanna, 2017). Al-Mothanna (2017) concluded that participants had positive feelings and intentions about using WhatsApp in their formal learning if it was introduced. Al-Mothanna (2017) and COL(2024) recommend empirical studies to examine the effectiveness of WhatsApp on students' learning outcomes and motivation at all levels of education.

Benefits of Video Conferencing Platforms:-

These platforms are used to hold live sessions and webinars. These live sessions usually simulate a real classroom and therefore, students and teachers can interact and promote engagement during remote and face-to-face learning. For example, during these live sessions, students can ask real-time questions and teachers can provide guidance. Some of the popular video conferencing platforms include Zoom, Microsoft Teams, WhatsApp and Google Meets (Yu, & Motlhabane, 2022, COL, 2024,). Learners can also pace themselves and access the course material from virtually anywhere. The learner's experience can be personalised therefore aiding in better user experience.

Al-Mothana (2017), notes that WhatsApp Messenger is a smartphone and web-based instant message application that allows users to share media information of text, image, video, and audio messages. WhatsApp is a free, easy-to-use, fast, appropriate, personal mode of communication (Church & de Oliveira, 2013).

WhatsApp can be utilised in higher education in various ways to meet diverse educational aims. For instance, Gachago, Strydom, Hanekom, Simons, and Walters (2015) suggested that WhatsApp can help establish instant connections, promote reflection and facilitate can be used in higher education to create immediate connections, encourage reflection, and help coordinate informal and formal settings. Chipunza (2013) discovered that WhatsApp was an effective electronic tool for sharing information among university students on various topics related to their studies. Al-Mothana (2017) noted that WhatsApp's widespread use and benefits indicate its potential to support formal learning, particularly in developing countries facing economic and infrastructure challenges.

Nyamayedenga (2021) observes that the use of WhatsApp has also the advantage of using visuals like pictures and videos which assists students to understand and conceptualise an idea vividly. This means students will use most of their senses and it develops their critical thinking skills (Nyamayedenga, 2021). Maphosa, Dube and Jita (2020) argue that WhatsApp is appropriate for 21st-century learning because it is collaborative and student-centred. This platform is very effective in dispensing skills and knowledge to learners hence fostering quick conceptualization of new ideas presented in the classroom or lecture(Nyamayedenga, 2020). Commonwealth of Learning COL (2024) notes that the lecturer can suggest concepts and include students in the discussion who can come up with information on any subject. This platform is ideal for giving students instant feedback on the topics they would have covered (COL, 2024).

WhatsApp learning-associated studies have been undertaken in several countries across the world. Wijaya (2018) found that numeracy and literacy skills improved through WhatsApp

online learning in Indonesia. In Pakistan, Cetinkaya (2017) studied the impact of WhatsApp use on success in teaching and learning and found that students developed positive attitudes about the use of WhatsApp in their courses. Another study in Pakistan by Minhas, Ahmed, and Ullah, (2016) established that WhatsApp is an important device used mainly for one-to-one or group communication.

According to Melitia (2015), inadequate student learning outcomes are hampered by weaknesses in teachers pedagogical content knowledge (PCK) and classroom practice both of which are developed through effective initial teacher education and continuing professional development (CPD) programs for teachers.

In a study in Palestine, Marwan and Safa (2020) observed that one of the advantages of WhatsApp is enhancing communication. WhatsApp can provide a tool for more consistent and smoother communication between students and teachers, thus creating new venues of education. The researchers further observed that WhatsApp also enables immediate synchronous communication, and it is easily accessible by people, including school students and teachers. The application is different from other social networks in that it maintains the privacy of the people involved, and things they exchange do not go public, as in the case of Facebook, for example (Marwan and Safa, 2020).

Objectives:-

General Objective

The study sought to assess the potential of the WhatsApp platform's versatility in supporting the teaching and learning of pedagogical skills to undergraduate students. We purposively selected the undergraduate STEM majors because the subjects are critical to country development and performance in the subjects is generally low.

Specific Objectives

The following were the specific objectives of this research:
1. To examine the use of the WhatsApp platform in developing pedagogical documents.
2. To determine university students' perceptions towards the use of WhatsApp in teaching and learning pedagogical skills

Materials and Methods:-

Both quantitative and qualitative analyses were employed in the research. Qualitative research was used to describe prospective teachers' perspectives of learning using the WhatsApp platform in teaching STEM pedagogy. All the 120 students in the STEM course were added to the class WhatsApp group by the course lecturer and learning materials were shared via the platform by the lecturer and the students. The data collection tools used were online Google form questionnaires and the respondents wrote their statements on their respective WhatsApp platforms and in-boxed the researcher to avoid duplication of respondents' views on the common platform which had the entire class population. The questionnaire was shared to all 120 students via the class WhatsApp platform.

Participants

The participants of this research were all STEM students undertaking a course in pedagogical skills in the third year of their study in Kenya University. The course is mandatory to all teacher trainees and prepares them for school teaching practice which is assessed and graded for the students. The teaching practice lasts three (3) months and teacher trainees are assessed on pedagogical skills of lesson planning, classroom management, resource material preparation, scheme of work development and record keeping. The students involved in the study were undertaking a pedagogical course in the STEM subjects of Mathematics, Physics, Biology, Chemistry and Computer Studies at the university level.

Results:-

The results of the study are discussed as per the following themes; participant demographics, use of WhatsApp in developing pedagogical documents, undergraduated students' perceived effectiveness of whatsApp and Focus Group Discussion results.

Participant Demographics

Table 1: Participants demographics

Gender	No.	Percent
Male	9	22.5
Femal	31	77.5
Subject Combination		
Physics/Maths	27	67.5
Physics/Computer	1	2.5
Physics/Chemstry	12	30.0
Physics/Biology	0	0.0

Table 1, shows that of the forty (40) respondents of the study a majority of the participants where male (77.5%) compared to female (22.5%). This means STEM subjects at the university level are taken by a few female students. Of the total 40 respondents of the study, a majority were taking Physics and Mathematics (67.5%) combination while no respondents were taking Physics and Biology combination.

Use of WhatsApp in Developing Pedagogical Documents

Table 2: Use of WhatsApp in Developing Teaching Documents

Statement	SA	A	N	D	SD
WhatsApp enabled me conceptualise syllabus interpretation during scheming and lesson planning sessions	23- (57.5%)	15 (37.5%)	1 (2.5%)	1 (2.5%)	0
WhatsApp enabled me to identify the components of the scheme of work	22 (55.0%)	10 (25%)	7 (17.5%)	1 (2.5%)	0
WhatsApp enabled me to easily conceptualize the filling of pedagogy documents	19 (47.5%)	12 (30%)	6 (15%)	3 (7.5%)	0
WhatsApp assisted me comprehend easily breaking a lesson plan in logical steps	21 (52.5%)	12 (30%)	6 (15%)	1 (2.5%)	0
WhatsApp enabled me write effectively lesson	20 (50%)	11 (27.5%)	6 (15%)	3 (7.5%)	0

introduction					
WhatsApp easily guided me on how to write lesson conclusion	13- (32.5%)	13 (32.5%)	10 (25%)	4 (10%)	0

Key: SA-Strongly Agree, A-Agree, N-Nuetral, D-Disagree and SD-Strongly Disagree

Table 2, indicates that over eighty (80%) percent of the study participants noted that WhatsApp enabled them conceptualise the interpretation of the syllabus which is key to lesson planing and general implementation of the school curriculum at classroom level.

Simalarly over seventy percent (70%) of the respondents agreed or strongly agreed that WhatsApp enabled them to identify the components of the scheme of work which include the time frame, content to be covered, objectives of the lessons, learning activities, resource materials and references sections.

Further, table 2 shows that over eight pecent (80%) of the respondents indicated that whatsApp aided them break their lesson plans into logical steps which are key to systematic presentation of a lesson during teaching and learning process.

Still further from Table 2, it is evident that a majority of the study participants strongly agreed or agreed that WhatsApp presentaion enable them easily write lesson introduction and conclusion effectively.

Table 3: Use of WhatsApp in sharing documents

Statement	SA	A	N	D	SD
WhatsApp facilitated sharing of pedagogy documents during the lecture	34 (85%)	4 (10%)	1 (2.5%)	1 (2.5%)	0
WhatsApp assisted me comprehend the relationship between physics pedagogy documents	22 (55.0%)	8 (20%)	6 (15%)	4 (2.5%)	0
WhatsApp increased my skills and knowledge of improvising learning resources.	27 (67.5%)	12 (30%)	0	1 (2.5%)	0

Key: SA-Strongly Agree, A-Agree, N-Neutral, D-Disagree and SD-Strongly Disagree

From Table 3, it is evident that over ninety percent (90%) of the study participants overwhelming accepted that WhatsApp is very effective in sharing documents during lectures. The learning materials that can be shared range from videos, powerpoint slides, text, photographs, pictures, audio and graphics. The participants further noted that WhatsApp supported them in comprehending the relationship between the pedagogical documents easily. Over ninety percent (90%) agreed that WhatsApp increased their knowledge of improvising learning materials implying the participants were able to conceptualize the key aspects of developing learning and teaching resources through improvisation.

Focus Group Discussions (FGD) Results

The study respondents were asked to write via WhatsApp platform "What they thought would have happened if WhatsApp had not been used in teaching the STEM subject pedagogy?
The responses of the participants were analysed and categorised into three themes namely application of WhatsApp in communication, sharing documents and conceptualisation of pedagogical skills.

Communication

The participants generally indicated that "*WhatsApp facilitated communication, discussions, and sharing of resources, but noted that alternative educational platforms such as video conferencing, or traditional teaching methods could not be applied also.*"

The participants further noted that "WhatsApp *enhanced lecturer communication: - since the lecturer was able to share learning documents instantaneously and that would have been not easy if the platform had not been utilised. Most of the content would not have reached the teacher trainees hence the learning would be ineffective*"

Other participants generally observed that "*WhatsApp enabled real-time interaction, allowing students to seek clarification or assistance from the lecturer promptly. Without such a platform, students would have to wait longer for feedback thus potentially affecting the learning process*".

The participants also noted that the use of "*WhatsApp minimized printing of lecture materials hence saving a lot of funds which could have been used in the printing process thus making the learning of pedagogical skills by teacher trainees a bit costly*"

Participants of the study further observed that "*communication challenges were minimized since WhatsApp allowed for instant messaging hence quick communication between students and teachers was enabled effectively. Without it, reliance on traditional methods (email, in-person communication) would have been slow hence poor information distribution between the pre-service teachers and the lecturer*"

According to some participants, "*The informal learning context created by the WhatsApp group platform provided students with an opportunity to express themselves freely while away from the lecturer halls or rooms hence facilitating continuous sharing and learning*"

Document sharing via WhatsApp

A number of the study participants noted that the "*WhatsApp group formed provided space for collaborative discussions among students. Without this platform, collaborative efforts might have been fragmented, making it harder for students to engage in group learning or projects.*"

Several participants also echoed that the "*WhatsApp platform allowed for the easy sharing of resources and document links, text materials and other multimedia resources. Without it, distributing and accessing educational materials could become less efficient.* Participants of the study further underscored that "*There would have been difficulty in sharing of documents to students from the lecturer and a challenge of managing class with large enrolment since information sharing will be difficult. Many lecture key points will be missed terribly by many students.*"

Participants also resounded that "*The world is changing and everything is moving towards technology in which science is the foundation, WhatsApp being one of the recent communication-based technologies it will be good for young scientists taking pedagogy in university to adjust to it use wholly. If the platform was not used, then it would sound like we aren't enthusiasts of science yet learning is becoming easier with the use of digital platforms like WhatsApp...*". *There would be limited sharing of learning materials and ideas from the lecturer to the learners hence limitation of exchange of ideas.*

A participant noted that without the use of WhatsApp, "*the learning process would have been hindered since lectures are characterised with fast transmission of information and documents from the lecture but the platform ensured that copies for reference remained on the platform.*"

Conceptualization of Documents

The participants of the study noted that *"It would be a challenge to understand some parts of the lecture such as how to make a scheme of work and a lesson plan. We would have had difficulty getting skills and knowledge of pedagogy documents and learning could have been a bit less effective". " The documents posted by the lecturer and fellow students on the WhatsApp platform remained on the platform for future reference hence reinforcing learning"*

One student noted that *"Understanding pedagogy could have been so hard since sharing of the many sample documents would have been a big challenge for colleagues and the lecturer. No one could have understood the pedagogical documents due to the fact the class was large."*

"The lecturer could not have reached most of the learners due to lack of space for lectures and most of the information could not have reached most learners".

Participants noted that *"They could not have conceptualized the syllabus interpretation during lesson planning and scheming without the application of the WhatsApp platform."*

Another participant noted that *"Some concepts would have been difficult grasp for example reading of vernier callipers and the general development of schemes of work and lesson plan."*

Several participants of the study noted that*"If WhatsApp was not used, they would not have covered the entire unit contents in the time since the platform facilitated document sharing widely among the study participants. A majority of the pre-service teachers we able to access the documents at the same time hence saving time and also giving the lecturer sufficient time to explain key facts and concepts of the lecture."*

"WhatsApp enabled the lecturer to explain key concepts of lesson planning and scheming vividly and systematically hence making the lecture interesting and motivating." Observed one participant.

Discussions

From the teacher trainee perspective, it is clear that WhatsApp platform enabled the trainees to conceptualise aspect of pedagogy which entail the development of detailed schemes of work and lesson plans. The students observed that the resources shared via WhatsApp in the form of text, pictures of documents, videos and slides made them quickly comprehend the materials that were presented to them. This result concurred with (Marwan and Safa, 2020; Al-Mothana, 2017; and Chipunza, P. R. C. 2013), who observed that the WhatsApp platform enables teachers to share a lot of educational materials with students as well as assist the students in collaborating in their learning. The platform facilitated instantaneous feedback during teaching between the teacher and students hence building both a virtual and physical classroom interaction.

Conclusions

In conclusion, it is noted that the use of the WhatsApp platform facilitated the conceptualization of pedagogical concepts, the sharing and development of pedagogical documents. It was also

noted that the lecturer or instructor and pre-service teachers shared the resources promptly and the materials remained on the platform for future use by the students. WhatsApp generally enabled the lecturer to teach large classrooms effectively because learning resources were shared fast and the cost of printing materials was lessened to a large extent.

Recommendations

It is recommended the stakeholders in the education sector carry out more studies on the application and use of WhatsApp in education as a solution to tackling challenges of teaching large classrooms at Primary and Secondary school level. Further, there is need to formulate policies to guide the use of WhatsApp in teaching and learning at allow levels of education.

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