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PRESERVICE MATHEMATICS TEACHERS' MOTIVATION TO STUDY ONLINE AMIDST COVID-19

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Abstract
The present study investigated the motivation of preservice mathematics education students to engage in online mathematics learning during the COVID-19 pandemic. The study employed the descriptive survey research method. The sample size of 240 students from the Department of Mathematics and ICT Education at the University of Cape Coast, Cape Coast, was determined using Krejcie and Morgan's (1970) table. Data from the students was collected using a questionnaire that was produced internally. The data collected was analysed using descriptive statistics, namely the mean and standard deviation. The research revealed that students exhibit a lack of motivation to engage in online mathematics learning, mostly attributed to the presence of diverse media formats such as audio, video, and textual materials. The adaptation of e-learning has been seen to provide challenges in the context of mathematics education. Specifically, the process of studying mathematics online is inherently difficult, leading to a lack of comfort and positivity among students. Furthermore, the online learning environment may not adequately facilitate the acquisition of new mathematical concepts. Consequently, students tend to express dissatisfaction with wholly online mathematics courses. The report provides recommendations based on its findings.

Keywords: Covid-19; E-learning; Mathematics; Motivation, Preservice

Introduction

The prevailing paradigm in the field of education theory is centred around the constructivist approach. The notion of constructivism in learning is defined as the active process of constructing new knowledge by drawing upon a learner's previous experiences (Dewey, 1916; Piaget, 1972; Vygotsky, 1978; Bruner, 1990). Students construct new knowledge by drawing upon their existing knowledge and personal experiences while also considering the contextual aspects present in their learning environment. Constructivists claim that cognitive processes are rooted in the interpretation of both physical and social encounters, which are comprehensible alone through the cognitive faculties of the mind. As a way of understanding and interpreting their perceptions, people build mental models, according to Jonassen (1991). According to Kant (2001), these mental models are a priori in nature, as opposed to being influenced by external structures. According to Koohang and Harman (2005), the constructivism learning theory, which emphasises the creation of knowledge through prior experiences, is well-suited for e-learning as it promotes effective learning among learners. Students engage in an active process of conceptual transformation, wherein they undergo a journey towards adopting a new schema of accommodation through the process of assimilation.

The National Union of Students in the UK conducted research and found that a sizable portion, specifically 27% of students enrolled in UK universities, had trouble accessing online coursework during the COVID-19 shutdown. The results of the study indicated that individuals with disabilities and those from disadvantaged socio-economic situations faced the most significant difficulties. Numerous educational institutions are providing complimentary access to their resources and solutions to facilitate and enhance the instructional process in a dynamic and captivating setting. Online learning has emerged as a platform that enables novel teaching and learning approaches, apart from the traditional classroom setting. However, it is worth noting that certain locations have expressed dissatisfaction with this mode of education. The advent of the COVID-19 pandemic has presented several opportunities for individuals and institutions lacking preparedness or long-term plans to use online education. This has resulted in numerous challenges for educators, schools, institutions, and government entities. The use of digital platforms, including Google Classroom, Zoom, and virtual learning environments, as well as social media platforms and diverse group forums such as Telegram, Messenger, WhatsApp, and WeChat, has been investigated and implemented as novel approaches to facilitate teaching and learning to sustain educational activities (Pokhrel & Chhetri, 2021). Further exploration of these

platforms has been undertaken even upon the resumption of face-to-face instruction to provide learners with extra resources and coaching. Public universities in Kenya are implementing e-learning as a way to improve the accessibility of higher education, according to a study by Mutisya and Makokha (2016).

However, only two out of Kenya's seven public universities had formally endorsed e-learning policies, indicating that the implementation of this educational strategy was still in its infancy (Mutisya & Makokha, 2016). Mutisya and Makokha's findings revealed that there was a limited adoption of e-learning among lecturers and students. They observed that only a small proportion of course units were available online, and the majority of the uploaded modules consisted of static PDF or Microsoft Word files. These files contained materials that were already present in the course handbooks, thus lacking the essential element of interactivity, which is crucial for effective e-learning. University administrators have acknowledged that the implementation of e-learning in public universities is behind schedule.
According to the findings of Walimbwa (2008), the implementation of e-learning in East African universities faced significant obstacles, mostly due to inadequate resources and a lack of commitment from the teaching community. Insufficient human capability and a dearth of skills have additionally led to the limited application of e-learning. The significant barrier of limited Internet bandwidth prevented the growth of e-learning in these colleges. Kasse and Balunywa (2013) identified significant deficiencies in infrastructure, including the lack of Internet access, technical inadequacy, and attitudinal obstacles, which hindered the widespread implementation of e-learning in Ugandan higher education institutions. Educators are required to cultivate innovative strategies that aid in surmounting the constraints associated with virtual instruction. According to Doucet et al. (2020), there exist significant prospects for collaboration, innovative problem-solving, and a receptive attitude towards acquiring knowledge from others and experimenting with novel methodologies among educators, parents, and students who have shared experiences.

Although there are several benefits and adaptability linked to the acquisition of mathematics using online platforms, some key elements have been highlighted as essential for the achievement of effective e-learning (McIsaac & Gunawardena, 1996). Motivation was identified as a significant element by Bekele et al. (2020). According to Brophy (2013), motivation plays a crucial role in both traditional face-to-face educational settings and online learning environments, influencing learning outcomes and academic achievements. The impact of motivation on the acquisition of knowledge encompasses its influence on the content, methodology, and timing of learning (Schunk, 1995). According to Schunk (2008), empirical evidence suggests that individuals who possess high levels of motivation are more inclined to engage in intellectually demanding tasks, actively participate in the learning process, derive satisfaction from their educational experiences, and adopt a profound approach to acquiring knowledge. Furthermore, motivated learners tend to demonstrate improved performance, sustained effort, and enhanced creative thinking abilities. Current perspectives connect motivation to the cognitive and affective processes of individuals, including their thoughts, beliefs, and aspirations. These views also highlight the importance of the dynamic and reciprocal interaction between the learner and the learning environment (Brophy, 2013).

Previous studies in the field of online motivation have commonly adopted one of two approaches. The initial approach employs a trait-like perspective, wherein motivation is perceived as a relatively stable and individual characteristic of the learner. Research from this perspective has provided support for the notion that online learners, on the whole, possess intrinsic motivation. The contrasting perspective centres on the strategic development of digital learning platforms to foster an ideal level of learner motivation. Both approaches fail to recognise a modern perspective on motivation that highlights the interconnectedness between the learner and the learning environment (Hartnett et al., 2011). Moreover, it is important to note that students from various regions exhibit distinct motivations for engaging in e-learning. According to Rovai et al. (2007) and Shroff and Vogel (2009), a comparison analysis conducted between online students and face-to-face students reveals that online students exhibit higher levels of intrinsic motivation compared to their on-campus counterparts, regardless of their academic level, whether it is undergraduate or postgraduate. There is a scarcity of research studies examining the desire to learn mathematics online in Ghanaian colleges, both in terms of quantity and breadth of coverage.

Statement of the problem

It is important to note that for online learning in mathematics to be effective, certain essential components need to be considered, as emphasised by McIsaac and Gunawardena (1996). Both Bekele et al. (2020) and Brophy (2013) recognise the significance of motivation as a key factor. The level of motivation has a significant impact on the results of learning and also has a crucial role in determining the content, approach, and timing of the learning process. Previous studies have examined motivation in online learning from various angles, such as individual traits and platform improvements. However, there is a lack of knowledge regarding the motivations of preservice mathematics

education students in Ghana during the COVID-19 pandemic. It is essential to gain insight into the motivations of preservice mathematics education students in Ghana during the pandemic. This understanding will help shape strategies to improve online learning experiences in mathematics. It is essential to focus on closing this gap in order to create specific strategies that promote motivation and improve the effectiveness of online mathematics education in Ghanaian colleges.

Aims and Objectives of the Study

This study investigated how preservice mathematics education students at one of the public universities in Ghana got motivated to study online during the COVID-19 pandemic. The objective that guided the study was to explore the factors that motivated preservice mathematics education students to learn mathematics online during the COVID-19 pandemic.

Research Question

What motivated preservice mathematics education students to learn mathematics online during the COVID-19 pandemic?

Methodology

The study employed the descriptive survey research method. The utilisation of this approach is favoured due to its incorporation of data collection to test hypotheses or address inquiries about the present state of the investigation. This facilitated the acquisition of data from a representative subset and its subsequent analysis to uncover the factors that drive preservice mathematics teaching students in a public university in Ghana to engage in online learning during the COVID-19 pandemic. The target audience for this study consisted of undergraduate students enrolled in the Department of Mathematics and ICT Education at the University of Cape Coast, Cape Coast. The participants in this study were preservice mathematics education students from the Department of Mathematics and ICT Education. They were instructed to complete a test instrument as part of the research, which aimed to evaluate their desire to engage in online learning during the COVID-19 pandemic. The researchers utilised Krejcie and Morgan's (1970) table for sample size determination to estimate the appropriate sample sizes for different levels of undergraduate students within the department, given an anticipated accessible population of 645 students. A total of 240 pupils were chosen for the study. The participants were selected randomly from academic levels ranging from 100 to 400 to complete the survey.

Data from the students was collected using a questionnaire that was produced internally. Participants were instructed to respond to all items included in the survey, indicating their level of agreement or disagreement. The survey instrument utilised in this study is designed as a closed-ended questionnaire, employing a 4-point Likert scale to measure respondents' agreement levels, ranging from 1 (strongly disagree) to 4 (strongly agree). In adherence to ethical guidelines in research, the researchers sought approval from the Department of Mathematics and ICT Education at the University of Cape Coast. This approval was obtained to facilitate the introduction of the researchers to preservice mathematics teachers and to solicit their assistance in collecting the necessary data for the study. The participants were provided with comprehensive information regarding the purpose of the study. The data obtained from the participants was handled with strict confidentiality, and the respondents were guaranteed anonymity about the information they provided. The researchers individually administered the questionnaires. This measure was implemented to optimise the response rate of the questionnaires. Sufficient time was allocated to the respondents for providing their responses to the items included in the questionnaire. To mitigate the influence of biases, participants were explicitly prohibited from engaging in discussions about the questions presented in the questionnaire.

Results

Demographic Characteristics of the Respondents

The researchers gathered data on the demographic characteristics of the respondents (gender and level). The results are presented in Figure 1.

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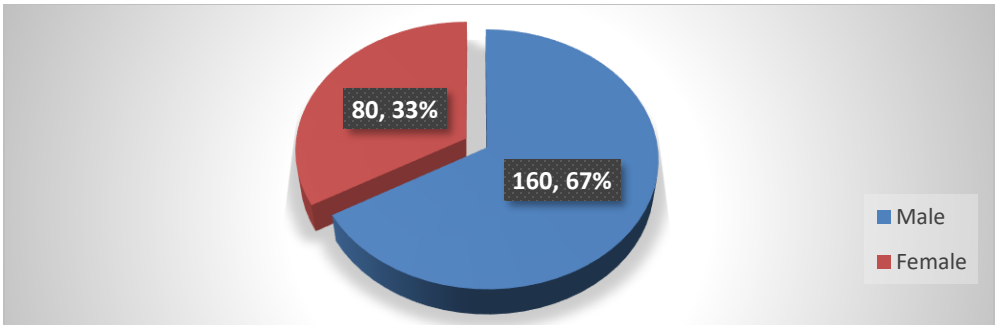

Fig. 1: Gender of the Respondents

Figure 1 showed the gender distribution of the respondents. The results showed that 160 respondents out of the 240 sampled are males. This number represents 67% of the entire population. However, 80 (33%) of the respondents were females. These values revealed that the majority of the respondents sampled for the study are males.

What motivates preservice mathematics education students to learn mathematics online?
This research question sought the views of the respondents about how they are motivated to learn mathematics online. A four-point Likert scale was used to solicit their views. Mean and standard deviation were used to analyse the results. A mean value of 2.5 and above indicates an agreement from the respondents to the statement, otherwise, they disagree with the statement. The result is presented in Table 1.

Table 1: Students' Motivation in Learning Mathematics Online

SN	Statements	Mean	Std. Deviation
1	Learning mathematics online is easy and flexible	2.32	2.038
2	I like entirely online mathematics courses	2.30	0.873
3	I like mathematics courses which use only digital textbooks	2.23	0.859
4	I enjoy learning mathematics online because I get to playback the recordings of all my lessons	2.21	0.909
5	Learning mathematics online provides timely input and feedback	2.21	0.770
6	I get to learn new things and interact with other students across the world	2.18	0.855
7	Learning mathematics online is interesting and of more impact than traditional face-to-face teaching and learning	1.96	0.707
8	Quizzes and examinations conducted on E-learning platforms in mathematics are much easier and more flexible	2.15	0.833
9	I feel comfortable and positive when learning mathematics online because I am familiar with E-learning tools	2.08	0.832
10	I am encouraged to mathematics learn online due to the multiple forms of media (audio, video, and textual) E-learning adapts	2.03	0.731

The results shown in Table 3 indicate the views of respondents about how they are motivated to learn mathematics online. The results showed that respondents disagreed that learning mathematics online is interesting and has more impact than traditional face-to-face teaching and learning (mean = 1.96, SD =.707). The students also disagreed that they are encouraged to learn online due to the multiple forms of media (audio, video, and textual) that e-learning adapts (mean = 2.03, SD =.731). Similarly, learning mathematics online is not easy and flexible (mean = 2.32, SD = 2.038) for the students; learning mathematics online does not provide timely input and feedback (mean = 2.21, SD =.770); and students do not feel comfortable and positive when learning mathematics online because they are not familiar with e-learning tools (mean = 2.08, SD =.832). Again, students disagreed that quizzes and examinations conducted on e-learning platforms are much easier and more flexible (mean = 2.15, SD =.833). They also indicated that they do not enjoy learning mathematics online because they get to playback the recordings of all my lessons (mean

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= 2.21, SD =.909). Also, students disagreed that they get to learn new things and interact with other students across the world (mean = 2.18, SD =.855), they do not like entirely online courses (mean = 2.30, SD =.873), and they do not like courses that use only digital textbooks (mean = 2.23, SD =.859).

Discussion

This study investigated the factors that motivated students to learn mathematics online during the COVID-19 pandemic. Firstly, the study showed that learning mathematics online is not easy or flexible. This does not corroborate the findings of Fakhrunisa and Prabawanto (2020). The acquisition of mathematical knowledge through online platforms poses distinct obstacles that may impact the perceived level of convenience and adaptability. Translating the intricacies of mathematics, which frequently necessitate interactive problem-solving and visual representation, into an online environment can pose challenges. The field of mathematics encompasses abstract concepts and problem-solving techniques that may pose challenges to comprehension without immediate guidance or interactive support. The provision of real-time assistance and immediate feedback on online platforms may pose challenges, potentially impeding students' comprehension and adaptability in effectively navigating intricate mathematical problems. The potential absence of interactivity and engagement in online mathematics courses is a notable concern when comparing them to the traditional classroom environment. The lack of face-to-face dialogues, cooperative troubleshooting, or practical engagements can diminish the dynamism and adaptability of the learning process, thereby affecting students' motivation and understanding. Many students may face challenges related to technology or experience difficulties when attempting to adapt to different digital tools and platforms utilised in the instruction of mathematics. The acquisition of unfamiliar software or the navigation of intricate interfaces can introduce an additional level of difficulty, thereby influencing the perceived level of ease and adaptability in online mathematics courses. The discovery that students exhibit a dislike for courses that are solely online or employ exclusively digital textbooks is a predictable outcome. This finding is not in line with the finding by Rovai et al. (2007), who found that online students are more intrinsically motivated across the board than their on-campus counterparts at both the undergraduate and postgraduate levels. Although e-learning presents numerous advantages, it is crucial to acknowledge that it may not be appropriate for every student or course format. Certain students may exhibit a preference for the conventional classroom environment due to its inherent structure and social reinforcement, whereas others may perceive digital textbooks or other web-based resources to be less immersive or efficacious than their print counterparts.

Again, students expressed dislike for mathematics courses that use only digital textbooks. The reluctance of preservice mathematics education students to engage with mathematics courses that exclusively utilise digital textbooks during the COVID-19 pandemic highlights the complex difficulties encountered in online learning settings. The COVID-19 pandemic has compelled educational institutions to swiftly transition to online learning. This transition has shed light on the constraints and inclinations of students concerning digital resources in the context of mathematics education. Additionally, the isolation resulting from the pandemic may have intensified students' inclination towards diverse learning modalities. The potential impact of extended periods of screen usage and reduced opportunities for social interaction with peers and educators may have contributed to an increased inclination towards seeking out a wider range of learning materials beyond the confines of digital textbooks. Due to the difficulty of recreating these aspects in a solely digital environment, students may have felt a desire for hands-on activities, discussions, and real-time collaborative problem-solving experiences.

The discovery that students exhibit a lack of enthusiasm towards online mathematics education due to the availability of recorded lesson playback is noteworthy. The utilisation of recorded lessons as a pedagogical resource can prove advantageous for students, especially those who were absent or required a review of a specific topic. However, it is plausible that the convenience of this feature may result in certain students becoming disengaged from the live sessions. The identified concerns regarding online mathematics learning pertain to the challenges faced by students in terms of timely input and feedback. These concerns are valid and suggest that students may struggle with e-learning tools due to a lack of familiarity. Online learning necessitates a certain level of independence and effective time management, both of which may not be qualities that all students possess. The absence of a conventional classroom environment may pose difficulties for students in terms of time management and sustaining motivation to fulfil academic requirements. Moreover, the absence of prompt feedback and guidance from educators can prove to be a source of frustration for certain students, potentially impeding their capacity to acquire and retain mathematical concepts proficiently. The fact that students expressed dissent towards their opportunities to acquire novel knowledge and engage with peers from diverse geographical locations is noteworthy. Online learning has the potential to facilitate global connections among students and educators, thereby offering valuable insights and perspectives on mathematical concepts and applications. It is plausible that students may have encountered limited chances to interact with their

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peers or may have perceived the virtual learning milieu as less favourable for social engagement compared to a conventional classroom ambience.

The results showed that learning mathematics online is not interesting and does not offer more impact than traditional face-to-face teaching and learning, which does not confirm the study by Mavridis et al. (2017). The aforementioned discovery is unsurprising, as the virtual instruction of mathematics may not encompass all the advantages inherent in conventional in-person pedagogy. The discipline of mathematics necessitates substantial practice and comprehension of fundamental principles, and the virtual mode of instruction may not furnish an equivalent degree of engagement and assistance as that of a conventional classroom milieu. Furthermore, the adoption of online learning may pose difficulties in upholding student engagement and motivation. This is due to the potential challenges of sustaining focus and motivation without the framework and communal backing of a traditional classroom setting. It is noteworthy that the transition to virtual learning as a result of the COVID-19 pandemic was abrupt and unforeseen, potentially leaving students with inadequate time to acclimatise to the novel instructional modality. The quality of online mathematics education is subject to significant variation, contingent upon the platform utilised, the calibre of instructional materials, and the pedagogical approaches implemented by educators. It is plausible that certain students may have encountered unfavourable encounters with virtual education, which could have impacted their outlook on its efficacy. The discovery that students expressed dissent towards the notion that quizzes and exams administered through e-learning platforms are significantly simpler and more adaptable is unsurprising. Although e-learning platforms may provide students with the convenience of taking quizzes and exams at their own pace and location, the complexity of the assessments is not expected to differ significantly from those administered in conventional face-to-face environments. Furthermore, the incorporation of technology in evaluations may pose distinct obstacles, including technical malfunctions and apprehensions regarding scholarly honesty.

Additionally, the students were not encouraged to learn online due to the multiple forms of media (audio, video, and textual) that e-learning adapts. This contradicts the research by Shroff and Vogel (2009), whose comparative study between online students and face-to-face students also suggests that online students are more intrinsically motivated across the board than their on-campus counterparts at both the undergraduate and postgraduate levels. The amalgamation of diverse media types, such as audio, video, and textual resources, is a crucial aspect of efficacious e-learning. The incorporation of multimedia resources in virtual mathematics instruction can potentially augment students' comprehension of intricate concepts, stimulate their curiosity and drive, and offer diverse channels for cognitive processing. It is crucial to acknowledge that the calibre and efficacy of multimedia materials utilised in virtual education can exhibit significant disparities. Certain multimedia resources may exhibit suboptimal design, insufficient interactivity or engagement, or may not conform to the learning objectives of the course. Furthermore, certain students may encounter constraints in accessing the requisite technology or bandwidth to adequately interact with multimedia materials, particularly in regions with restricted internet connectivity.

Conclusion

The findings support the hypothesis that the difficulties of online learning have a negative impact on university students' motivation to study mathematics during the COVID-19 pandemic. According to the study, using a variety of media in e-learning may make it difficult for students to learn mathematics effectively, which discourages them from engaging with the subject online. To encourage student engagement and motivation, educators must take into account the particular difficulties of online learning and modify their teaching strategies accordingly. With a focus on addressing the issues raised in this study, more research is required to investigate efficient methods for promoting mathematics learning in an online setting. From the finding that online mathematics education presents difficulties, it can be inferred that the COVID-19 pandemic has presented formidable obstacles for college-level mathematics learners. The research indicates that the challenges linked with virtual learning, including technological glitches and the absence of personal interaction with educators, could potentially have an adverse effect on students' inclination to engage in the study of mathematics. Hence, educators must recognise and tackle these obstacles to foster student engagement and motivation in the virtual learning milieu. Additional investigation is required to examine efficacious tactics for surmounting these hindrances and augmenting the calibre of mathematics instruction within the framework of remote education.

Drawing from the observation that students experience discomfort and negativity while engaging in online mathematics education, it may be inferred that the COVID-19 pandemic has presented considerable obstacles for university-level mathematics students. The research indicates that the virtual learning milieu may not furnish learners with an equivalent degree of assistance and involvement as conventional classroom contexts, which could result in

reduced drive and an unfavourable disposition towards mathematics. Hence, educators must acknowledge the distinctive obstacles linked to virtual learning and formulate tactics to foster a constructive learning milieu that stimulates student participation and drive. Additional investigation is required to examine efficacious methodologies for augmenting the calibre of mathematics instruction in the digital milieu and fostering a constructive educational encounter for pupils.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Modify teaching strategies to address difficulties in online learning, such as the use of various media hindering effective mathematics education. Tailor approaches to enhance engagement and motivation in the virtual setting.
2. Proactively address technological glitches and the lack of personal interaction with educators in virtual learning. Explore alternative methods to foster student-teacher engagement and communication.

References

Bekele, F., Sheleme, T., Fekadu, G., & Bekele, K. (2020). Patterns and associated factors of COVID-19 knowledge, attitude, and practice among general population and health care workers: A systematic review. *SAGE open medicine*, *8*, 2050312120970721.

Brophy, J. E. (2013). *Motivating students to learn*. Routledge.

Bruner, J. (1990). Culture and human development: A new look. *Human Development*, *33*(6), 344-355.

Dewey, J. (1916). Nationalising education. *Journal of Education*, *84*(16), 425-428.

Doucet, A., Netolicky, D., Timmers, K., Tuscano, F. J. (2020). Thinking about pedagogy in an unfolding pandemic (An Independent Report on Approaches to Distance Learning during COVID-19 School Closure). Work of Education International and UNESCO. https://issuu.com/educationinternational/docs/2020_research_covid-19_eng

Fakhrunisa, F., & Prabawanto, S. (2020, November). Online learning in COVID-19 pandemic: An investigation of mathematics teachers' perception. In *Proceedings of the 2020 4th International Conference on Education and E-Learning* (pp. 207-213).

Hartnett, M., St George, A., & Dron, J. (2011). Examining motivation in online distance learning environments: Complex, multifaceted, and situation-dependent. *International Review of Research in Open and Distributed Learning*, *12*(6), 20-38. retrieved on August 8, 2021, from: http://www.irrodl.org/index.php/irrodl/article/download/1030/1954

Jonassen, D. H. (1991). Evaluating constructivist learning. *Educational technology*, *31*(9), 28-33.

Kant, I. (2001). *Basic writings of Kant*. Modern Library.

Kasse, J. P., & Balunywa, W. (2013, February). An assessment of e-learning utilisation by a section of Ugandan universities: challenges, success factors and way forward. In *International conference on ICT for Africa* (Vol. 15).

Koohang, A., & Harman, K. (2005). Open source: A metaphor for e-learning. *Informing Science*, *8*.

Krejcie, R., & Morgan, S. (1970). Sample size determination. *Business Research Methods*, *4*(5), 34-36.

Mavridis, A., Katmada, A., & Tsiatsos, T. (2017). Impact of online flexible games on students' attitude towards mathematics. *Educational Technology Research and Development*, *65*, 1451-1470.

McIsaac, M. S., & Gunawardena, C. N. (1996). Distance education. *Handbook of research for educational communications and technology*, *403*, 437.

Mutisya, D. N., & Makokha, G. L. (2016). Challenges affecting adoption of e-learning in public universities in Kenya. *E-Learning and Digital Media*, *13*(3-4), 140-157.

Piaget, J. (1972). *Development and learning*. Reading in child behavior and development (p. 38-46).

Pokhrel, S., & Chhetri, R. (2021). A literature review on impact of COVID-19 pandemic on teaching and learning. *Higher Education for the Future*, *8*(1), 133-141.

Rovai, A., Ponton, M., Wighting, M., & Baker, J. (2007, July). A comparative analysis of student motivation in traditional classroom and e-learning courses. In *International Journal on E-learning*, 6 (3), 413-432). Association for the Advancement of Computing in Education (AACE).

Schunk, D. H. (1995). Self-efficacy, motivation, and performance. *Journal of Applied Sport Psychology*, *7*(2), 112-137.

Schunk, D. H. (2008). Metacognition, self-regulation, and self-regulated learning: Research recommendations. *Educational Psychology Review*, *20*, 463-467.

Shroff, R. H., & Vogel, D. R. (2009). Assessing the factors deemed to support individual student intrinsic motivation in technology supported online and face-to-face discussions. *Journal of Information Technology Education Research*, *8*(1), 59-85.

Vygotsky, L. S., & Cole, M. (1978). *Mind in society: Development of higher psychological processes*. Harvard university press.

Walimbwa, M. (2008). Integrating e learning in teaching and research in upcoming East African regional Universities. In *meeting CNIE Banff, Alberta, Canada.* Retrieved from http://www. slideshare. net/Walimbwa/elearning-in-east-african-universities.