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Artificial Intelligence-Based Tools and Students' Motivation in Mathematics in the Calabar Education Zone of Cross River State, Nigeria

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Abstract
This study quantitatively examined artificial intelligence – based tool and students' motivation in mathematics in Calabar Education Zone of Cross River State, Nigeria. The research design adopted for this study was the correlational design. The researcher adopted a purposive sampling technique to select four schools for the study. The researcher applied simple random sampling technique where ten percent (10%) of the total number of schools in each zone were selected as sample schools for the study. Also, the researcher adopted the stratified random sampling technique which was consider ideal to cover the distinct sub-groups made up of male and female. The study has a sample size of two hundred (200) SS2 students from four selected schools in the two LGAs selected for the study. The instruments used for data collection and analysis were observational technique for teachers to assess their teaching effectiveness in the use of the two artificial intelligence – based tool and Mathematics Achievement Test (MAT) for students' assessment of academic achievement. Data from instruments were analyzed using Pearson Product Moment Correlation Analysis to test the research hypotheses formulated. The findings revealed that there was significant relationship between ChatGPT, automated grading systems and students' motivation in learning mathematics in the study area. The study recommended among others that the state should organize training that will build teachers skills in the use of artificial intelligence – based tool such as ChatGPT and automated grading systems; specialists in computer application should be employed as a permanent staff to mentor other teachers in the use of artificial intelligence – based tool for instruction.

Keywords: Artificial Intelligence – Based Tools, ChatGPT, Automated Grading Systems, Students' Motivation, Calabar Education Zone.

Introduction

Artificial intelligence (AI) tool have permeated various industries and disciplines, including education, healthcare, banking, transportation, gaming, and customer service. Apple's Siri, Amazon's Alexa, ChatGPT, and Google Assistant have become commonplace AI-powered digital assistants that affect our decision-making and preferences as well as assist in education processes. AI can transform several industries, including education. In the field of mathematics education, AI offers novel solutions that have the potential to alter how students learn, teachers teach, and educational institutions operate. The influence of AI on mathematics education is significant in personalized learning, from individualized learning experiences to sophisticated problem-solving tools. One of the primary benefits of AI in mathematics education is individualized learning. AI- powered platforms can assess individual students' strengths and weaknesses, learning styles, and rates of cognitive growth (Jaiswal & Arun, 2021; Owan et al., 2023; Upadhyay & Khandelwal, 2019). Encouraged by the National Council of Teachers of Mathematics (NCTM, 2000), and facilitated by increased availability and decreased cost, technology use in mathematics classrooms is omnipresent, but varies in both form and use. Graphing calculators, smart phone apps, interactive white board technologies, dynamic geometry software, automated grading system and intelligent tutoring systems are examples of common technologies used in mathematics classrooms today. There is very little research on how teachers use technologies like intelligent tutoring systems and how their conceptions of mathematics might influence their use in Calabar Education Zone.

Motivation is one of the factors that influence the effectiveness of learning. Motivation is an effort done consciously to take action, to learn, and to realize directed behavior to achieve the expected goals in learning interaction (Beres, 2011). Motivation to learn plays a role in fostering a sense of pleasure and enthusiasm for

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learning (Setiawan, 2016). Motivation will move students to carry out learning activities. If students are motivated to carry out learning activities, it will have an impact on student learning outcomes. Habgood and Ainsworth (2011) asserted that student learning outcomes will be optimal if students are motivated to learn. That is, the existence of good motivation in learning will produce good learning outcomes. If students are more motivated to learn, then they tend to be involved and if they are involved, it is more likely for them to achieve learning goals (Kitching & Wheeler, 2013). Related to the process of learning mathematics, learning motivation needs to be instilled during learning, including growing strong impulses and learning needs, fostering attention and interest in mathematics, practicing perseverance in facing difficulties, and fostering desire to succeed (Lestari, 2014). Student motivation is divided into two types, namely intrinsic and extrinsic motivation (Harandi, 2015). Students who are intrinsically motivated deeply involve themselves in learning from something unique, interesting, or fascinating to achieve their academic and personal goals. On the other hand, students who are extrinsically motivated are motivated due to external influences such as grades, gifts, rewards, status, ridicule, punishment, and so on. So students will try if there are stimuli from outside students. The intensity of student motivation will greatly determine the level of learning outcomes.

The present world is dominated mainly by artificial intelligence and Machine Learning. One of the most impactful inventions made possible using Artificial Intelligence is AI powered chatbots or to be more specific ChatGPT. ChatGPT, developed by OpenAI, is an acronym for Chat Generative Pre-trained Transformer, representing its full name (https://openai.com/blog/chatgpt). ChatGPT participates in dialogue which allows ChatGPT to respond to follow-up inquiries, acknowledge mistakes, refute unfounded assumptions, and reject improper requests (Kazi, Muhammad, Sanjid, Zarif & Al-Jobair, 2023). After the introduction on 30th November, 2022, ChatGPT gained around 100 million users and 1.8 billion visitors per month up to 16th May, 2023 (Kazi et al., 2023). ChatGPT demonstrates its impact on various sectors and one of them is the Academic or educational sector. Intelligent tutoring systems (ITS), which may be utilized to resemble one-on-one private tuition, are one good example. According to the results of a meta-analysis, ITS typically had a fairly advantageous influence on undergraduate students' academic achievement (Steenbergen & Cooper, 2014). ChatGPT finds utility in a wide array of domains, demonstrating its versatility and ability to cater to various applications across different industries, sectors, and fields of expertise (Ray, 2023). Within the realm of education, ChatGPT can enhance individualized learning encounters by addressing student inquiries and delivering educational materials, while also being harnessed in content generation tasks, assisting users in generating written content like articles, narratives, and code segments (Ray, 2023; Kasneci et al., 2023).

The inappropriate usage of ChatGPT for plagiarism might have a significant negative impact on the motivation of learners (Ali et al., 2023). The presence of AI-generated content offers immediate gratification, enabling students to swiftly produce essays or research papers without exerting the required effort and reflection, potentially resulting in reduced motivation to independently research, study, and engage in critical thinking, leading to a loss of intrinsic motivation for exploring novel concepts, pushing boundaries, and cultivating their distinct viewpoints (Samaniego- Erazoet al., 2015).Automated grading and feedback systems can also provide teachers with data on student performance, which can help them identify areas where students are struggling and adjust their lesson plans accordingly. Automated grading and feedback with AI allow teachers to save time on grading, providing them with more time for other teaching responsibilities. By automating the grading process, teachers can reduce the amount of time and energy they spend on grading, allowing them to focus on other important tasks, such as lesson planning, creating engaging learning experiences, and providing individualized support to students.

Getting Started with the AGS System

i. Logging in

As an admin user of the AGS system you will have already been supplied with a username and password. To log into the AGS system enter your email address and password into the login box on the left-hand side of the AGS login screen (see Figure 5).

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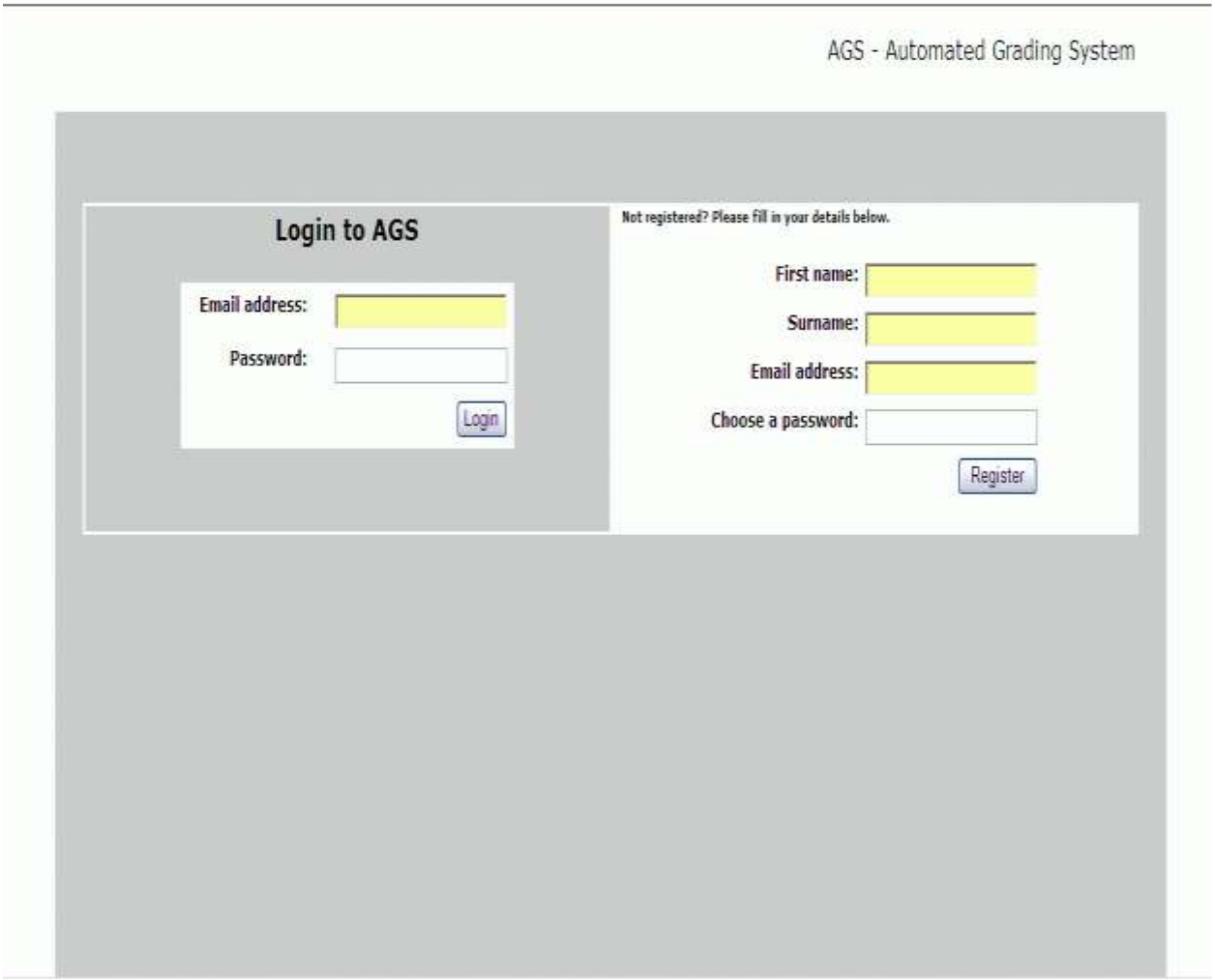

Figure 5: AGS login page

ii. Finding Your Way Around

As an admin user of the AGS system you have access to the Assignments, Corpora, Documents, Admin, and Help Sections of the AGS. These sections are accessed by clicking on the tabs at the top of the user interface (Figure 6). These sections will be described below in more detail. To logout of the AGS at any time, click the "logout" link located underneath the AGS logo on the top right of the page.

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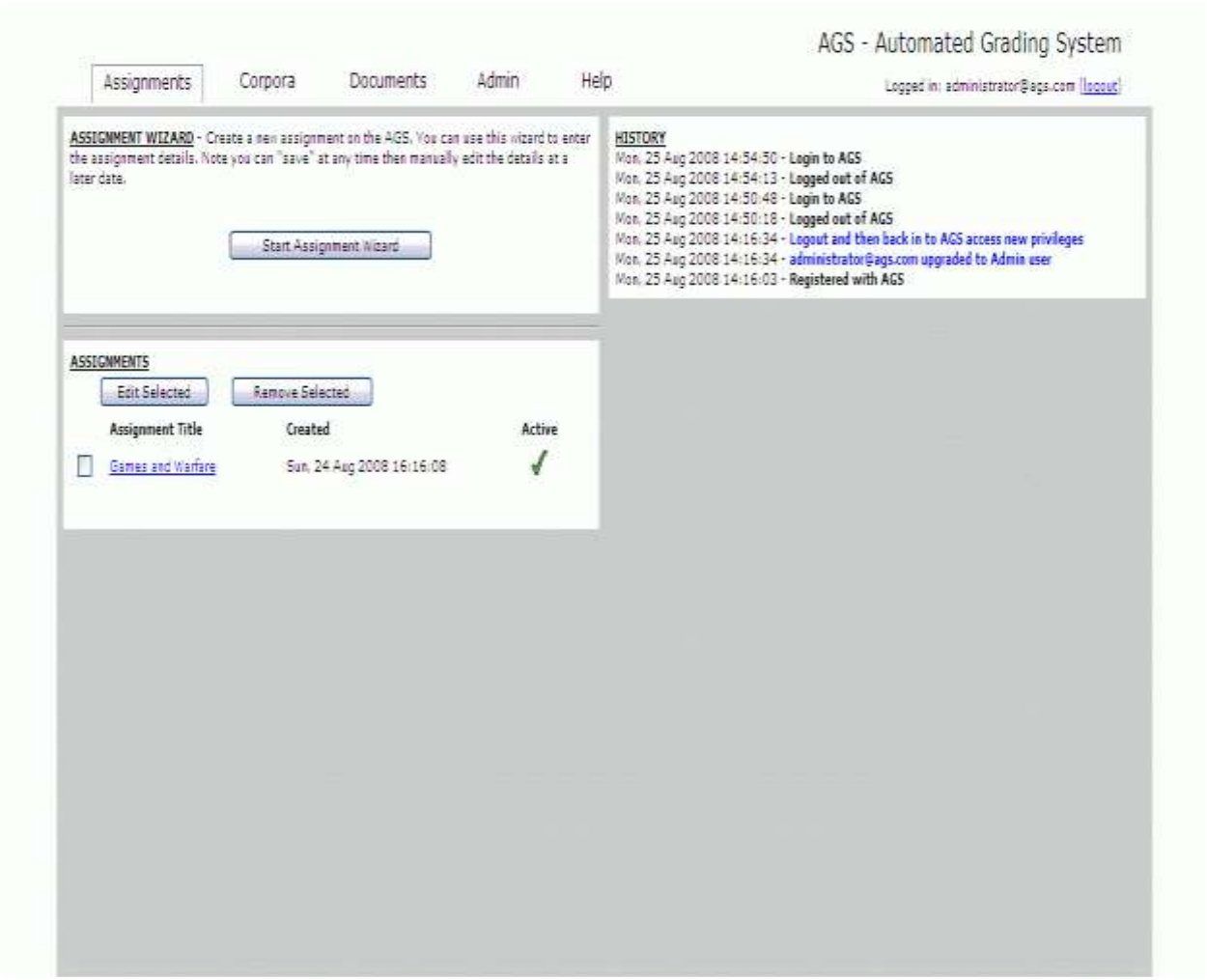

Figure 6 AGS administrator user interface (Assignments Page)

Teachers are the gatekeepers of technology implementation for learning in their classrooms (Meremikwu, et al., 2023). What technology students use to engage with mathematics, the frequency of technology use, and the type of learning which accompanies technology use are all mediated by the mathematics teacher.

ChatGPT and students' motivation in mathematics

ChatGPT name is combines two things, "chat" refers to the artificial intelligence AI chatbot and GPT stands for generative pre-trained transformer which is a language learning model (WIKIPEDIA, 2023). Language learning model also refers as machine learning model that is trained to do probability distribution through words. In simpler words, it predicts the best possible response and words to fill in blank spaces, phrases, and sentences (Altexsoft, 2023).

According to (Firat, 2023) ChatGPT can be considered a valuable tool for education. He also states that it can promote independent learning as well as autodidactic experiences which means a person's ability to learn a subject without a formal education or training. (Firat, 2023) also considers it to be an adaptable and practical approach by further providing more personalized feedback and support, it can create more engagement and motivation among the self-taught learners (Ali et al., 2020). Firdouset al., (2023) employ a quantitative method to examine the impact of ChatGPT on student academic performance in various universities across Pakistan. An online survey was distributed, garnering responses from 37 students at several institutions. The questions focused on demographic details and the impact of ChatGPT on academic performance parameters such as learning, quality of work, and creativity, with the role of prompt engineering as a mediating factor. Data was analysed by using SPSS, with Cronbach's alpha used to ensure reliability and internal consistency of the responses, which showed a high degree of correlation among responses. The results indicated a positive relationship between the use of ChatGPT and academic performance (Naveed et al, 2023). However, while most students were aware of ChatGPT's capabilities, the majority did not use it for examination preparation. The study also found that prompt engineering played a

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mediating role between ChatGPT usage and student academic performance, highlighting the importance of effective prompt design in optimizing the benefits of AI in educational settings.

Kazi et al. (2023) explore the impact of ChatGPT on academic performance of Bangladeshi undergraduate students in light of plagiarism, creativity and motivation. Data from 100 undergraduate students who had access to the ChatGPT in its infancy in early 2023 were gathered using a quantitative research design. The sample had been chosen utilizing a purposive sampling technique through conducting a 15-item structured online survey. The finding highlights that there is relation between plagiarism and creativity; creativity and motivation; creativity, plagiarism, motivation and academic performance. The research shows that ChatGPT is impacting creativity which is impacted by plagiarism and motivation is impacted by creativity and all the factors have an impact on academic performance. Institutions should encourage a proper way to help the students get off this dependency on ChatGPT and promote innovation and unique ideas among the students.

Automated Grading Systems and Students' motivation in Mathematics

The use of computer-based systems in classrooms has provided teachers with new opportunities in delivering content to students, supplementing instruction, and assessing students' knowledge and comprehension. Among the largest benefits of these systems is their ability to provide students with feedback on their work and also report student performance and progress to their teacher. While computer-based systems can automatically assess student answers to a range of question types, a limitation faced by many systems is in regard to open-ended problems. Due to recent advancements in natural language processing methods, the automation of essay grading has made notable strides. However, much of these researches have pertained to domains outside of mathematics, where the use of open-ended problems can be used by teachers to assess students' understanding of mathematical concepts beyond what is possible on other types of problems (Erickson et al., 2020).

Numerous studies have been carried out on the effect of automated grading system on teaching/learning. Matthew et al. (2012) carried out a study which focuses on the development and implementation of an adaptive learning and grading system with a goal of increasing the effectiveness and quality of feedback to students. To understand the impact of the system on feedback, three hypotheses were created and experiments were developed to test them. The system was shown to positively affect the quantity of feedback and reduce the time required for grading assignments. Likewise, Vladimir and Elena (2020) carried out a study on the effective use of a computer grading system for teaching Mathematics at a University. Quasi-experimental research design was adopted in the study. Multistage sampling technique was used to sample 80 students and 20 mathematics teachers for the study. A structured questionnaire and interview was used to collect data. The finding indicates that students taught using the Computer Grading System outperform their counterparts taught using conventional approach. Also, the results indicate that use of Computer Grading System enhances academic motivation.

Similarly, Weiyi et al. (2020) conducted a study to evaluate the efficacy of one such automated grading approach when applied in two real world settings: a beginner undergraduate class of 103 students required to create an object-oriented design model, and an advanced undergraduate class of 89 students elaborating a domain model. The results of the experiment highlight a) the need to adapt the grading strategy and strictness to the level of the students and the grading style of the instructor, and b) the importance of considering multiple solution variants when grading.

Statement of the Problem

The advent of the COVID-19 pandemic calls for an innovative approach in teaching and learning. The National Policy on Education in Nigeria (NPE, 2004) has highlighted the importance of integrating technology in teaching and learning. The Ministry of Education provides trainings to many school teachers each year to promote the use of ICT education. The trainings are provided to the teachers who teach the ICT related course in schools. These trainings have been limited to computer operation and they are not integrated into the teaching and learning of mathematics and other subjects. In this context, the application of artificial intelligence–based tool in mathematics education has not yet been fully realized in schools in Cross River State (especially, Calabar Education Zone). Many teachers of mathematics in the study area may have informal knowledge of technology (computers and tool), but there is no concerted effort to help them in the integration of artificial intelligence–based tool in mathematics instruction.

There is a global recognition of the important role Mathematics play in national and international developments. In Nigeria for instance, the study of Mathematics is made compulsory for students in all schools and a credit pass in Mathematics is a pre-requisite admission requirement for all courses in tertiary institutions. WAEC Chief

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Examiner Reports revealed that students demonstrated significant weakness in core Mathematics concepts (WAEC, 2018). To remediate the observed significant weakness in core Mathematics concept, WAEC Chief Examiner (WAEC, 2018) recommended that teacher should endeavour to use interactive method of teaching and that teacher should teach the subject both theoretically and practically with example. To make Mathematics interactive, practical and provide real life example, teacher have to integrate artificial intelligence – based tool in classroom instructions. It is on this premise that the study examines artificial intelligence – based tools and students' motivation in mathematics in Calabar Education Zone of Cross River State, Nigeria.

Purpose of the study

The main purpose of the study is to examine artificial intelligence – based tools and students' motivation in mathematics in Calabar Education Zone of Cross River State, Nigeria. Specifically, the objectives of the study are to:

1. Examine ChatGPT and students' motivation in mathematics.
2. Assess automated grading systems and students' motivation in mathematics.

Hypotheses

In the light of the above stated research questions, the following hypotheses were formulated for this study:

1. There is no significant relationship between ChatGPT and students' motivation in mathematics in Calabar Education Zone.
2. There is no significant relationship between automated grading systems and students' motivation in mathematics in Calabar Education Zone.

Methodology

The research design adopted for this study was the correlational design. This design was considered appropriate because this research was designed to explore the nature of the statistical relationship between artificial intelligence – based tools and students' academic motivation in mathematics in Calabar Education Zone, Coss River State, Nigeria. The study area is Calabar Education Zone. The area has two categories of schools - private and public schools. The population for the study is public secondary schools' teachers and senior secondary school two (SS II) students in Calabar Education zone. There are 85 public secondary schools comprising 85 SS II Mathematics teachers (consists of 53 male and 32 female Maths teachers) in Calabar Education Zone. Also, the zone has 3,036 SS II students which comprised 1,488 males and 1,548 females (Cross River State Secondary Education Board; CRSSEB, 2021). The researcher adopted a purposive sampling technique to select four schools for the study. The main purpose for using purposive sampling technique was to select schools with ICTs facilities. To get the required number of schools to be sampled from each public secondary schools, the researcher applied simple random sampling technique where ten percent (10%) of the total number of schools in each zone were selected as sample schools for the study. Also, the researcher adopted the stratified random sampling technique which was consider ideal to cover the distinct sub-groups made up of male and female. The study has a sample size of two hundred (200) SS2 students from four selected schools in the two LGAs selected for the study. The instruments used for data collection and analysis were observational technique for teachers to assess their use of the two artificial intelligence – based tools and Mathematics Achievement Test (MAT) for students' assessment of academic achievement. To determine the face and content validity of the instrument, copies of the Mathematics Achievement Test (MAT) was given to two experts from Measurement and Evaluation unit of Department of Educational Foundations, University of Calabar. To determine the reliability of the instrument (MAT) designed by the researcher, the scores obtained from the trial testing was subjected to Kudar – Richardson formula 20 (KR – 20) which gave a reliability co-efficient of 0.73. The Kuder-Richardson was appropriate for determining the reliability of the instrument because the instrument required only one correct answer in each case.

Results

Data collected through the copies of the questionnaire administered were analyzed using Pearson Product Moment Correlation Analysis to test the research hypotheses formulated.

Discussion

The finding from hypothesis two revealed that there was a significant relationship between automated grading systems and students' academic motivation in mathematics in the study area. This finding is in consonant with the finding of Vladimir and Elena (2020) who carried out a study on the effective use of a computer grading system for teaching Mathematics at a University. Quasi-experimental research design was adopted in the study.

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The finding indicates that students taught using Computer Grading System outperform their counterpart taught using conventional approach. Also, the results indicate that use of Computer Grading System enhances academic motivation. Also, the result is in line with Matthew, Janicki, He and Patterson (2012) who carried out a study which focuses on the development and implementation of an adaptive learning and grading system with a goal to increase the effectiveness and quality of feedback to students. The system was shown to positively affect the quantity of feedback and reduce the time required for grading assignments.

Conclusion

Based on the study's findings, it was concluded that there was a significant relationship between automated grading systems and students' academic motivation in mathematics in the study area.

Recommendations

Based on the findings of the study, it was recommended that:

1. The state should organize training that will build teachers skills in the use of artificial intelligence – based tool such as ChatGPT and automated grading systems.
2. Specialists in computer application should be employed as a permanent staff to mentor other teachers in the use of artificial intelligence – based tool for instruction.
3. Government and school administrators should empower teachers with the necessary skills on how to integrate artificial intelligence – based tool in teaching and learning.

References

Ali, J., Shamsan, M., Hezam, T. & Majeed, A. (2023). Impact of ChatGPT on Learning Motivation: Teachers and Students' Voices, vol. 2, pp. 41–49; doi: 10.56540/jesaf.v2i1.51.

Beres, P. J. (2011). *Project-based learning and its effect on motivation in the adolescent mathematics classroom* [Unpublished master's thesis]. State University of New York

Erickson, J. A., Botelho, A. F., McAteer, S., Varatharaj, A. & Heffernan, N. T. (2020). The Automated Grading of Student Open Responses in Mathematics. In Proceedings of the 10th International Conference on Learning Analytics and Knowledge (LAK '20), March 23–27, 2020, Frankfurt, Germany. ACM, New York, NY, USA, 53-63. https://doi.org/10.1145/ 3375462.3375523

Firdous, A. S., Raj, M., Alia, M., & Osman, B. S. (2023). Effects of ChatGPT on Students' Academic Performance:Mediating Role of Prompt Engineering. Asian Bulletin of Big Data Management 3(2), 137-147.

Harandi, S. R. (2015). Effects of e-learning on students' motivation. *Procedia - Social and Behavioral Sciences*, *181*, 423–430. https://doi.org/10.1016/j.sbspro.2015.04.905

Jaiswal, A. & Arun, C. J. (2021). Potential of artificial intelligence for transformation of the education system in India. International Journal of Education and Development using Information and Communication Technology, 17(1), 142-158.

Kasneci et al. (2023). ChatGPT for Good? On Opportunities and Challenges of Large Language Models for Education, vol. 103, p. 102-114, doi: 10.1016/j.lindif.2023.102274.

Kazi, T., Muhammad, S. I., Sanjid, B. K. S., Zarif, A. S., & Al-Jobair, I. A. (2023). Impact of ChatGPT on Academic Performance among Bangladeshi Undergraduate Students. International Journal of Research in Science & Engineering, 3(5), 18-28.

Kazi, T., Muhammad, S. I., Sanjid, B. K. S., Zarif, A. S., & Al-Jobair, I. A. (2023). Impact of ChatGPT on Academic Performance among Bangladeshi Undergraduate Students. International Journal of Research in Science & Engineering, 3(5), 18-28.

Kim, K., & Frick, T. W. (2011). Changes in Student Motivation During Online Learning. *Journal Educational Computing Research*, *44*(1), 1–23.

Kitching, L., & Wheeler, S. (2013). Playing games: Do game consoles have a positive impact on girls' learning outcomes and motivation? *European Journal of Open, Distance and Elearning*, *16*(2), 111-122.

Matthew, K., Janicki, T., He, L. & Patterson, L. (2012). Implementation of an Automated Grading System with an Adaptive Learning Component to Affect Student Feedback and Response Time. Journal of Information System, 23(1), 71-84.

Meremikwu, A. N., Ekwueme, C.O. & Opoh, D.A. (2023). Modern Teaching Strategies And Mathematics Academic Achievement among Junior Secondary School Students In Post– Covid–19 Era In Calabar Education Zone, Cross River State, Nigeria. *Global Journal of Educational Research Vol 22 (1), 2023: 1-9.*

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

Owan, V. J., Abang, K. B., Idika, D. O., Etta, E. O., & Bassey, B. A. (2023). Exploring the potential of artificial intelligence tools in educational measurement and assessment. Eurasia Journal of Mathematics, Science and Technology Education, 19(8), em2307. https://doi.org/10.29333/ejmste/13428

Ray, P. P. (2023). ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope. Internet Things Cyber-Phys. Syst., vol. 3, pp. 121-154; doi: 10.1016/j.iotcps.2023.04.003.

Samaniego- Erazo, G. N., Esteve-González, V. & Vaca, B. (2015). Teaching and Learning in digital worlds: strategies and issues in higher education," pp. 129–136.

Setiawan, A. (2016). Hubungan Kausal Penalaran Matematis terhadap Prestasi Belajar Matematika pada Materi Bangun Ruang Sisi Datar ditinjau dari Motivasi Belajar Matematika Siswa. *Al-Jabar*, *7*(1), 91–100.

Steenbergen, H. S. & Cooper, H. (2014). A meta-analysis of the effectiveness of intelligent tutoring systems on college students' academic learning. Journal of Education Psychology, 106 (2), 331–347; doi: 10.1037/a0034752.

Upadhyay, A. K. & Khandelwal, K. (2019). Artificial intelligence-based training learning from application. Development and Learning in Organisations, 33(2), 20-23. https://doi.org/10.1108/DLO-05-2018-0058

Vladimir, A. T. and Elena, G. L. (2020). Effective Use of a Computer Grading System for Teaching Mathematics at a University. ITM Web of Conferences 35, 03017 (2020).

Weiyi, B., Omar, A. & Jörg, K. (2020). Is Automated Grading of Models Effective? Assessing Automated Grading of Class Diagrams. In ACM/IEEE 23rd International Conference on Model Driven Engineering Languages and Systems (MODELS '20), October 18–23, 2020, Montreal, QC, Canada. ACM, New York, NY, USA, 12 pages. https://doi.org/10.1145/3365438. 3410944

Zhu, I. C., Sun, M., Luo, J., Li, T. & Wang, M. (2023). How to harness the potential of ChatGPT in education?, vol. 15, pp. 133–152; doi: 10.34105/j.kmel.2023.15.008.