Global Academic Journal of Humanities and Social Sciences

Available online at https://www.gajrc.com
DOI: https://doi.org/10.36348/gajhss.2024.v06i05.001

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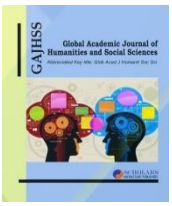

ISSN:2706-901X (P)
ISSN:2707-2576 (O)

Original Research Article

Impact of AI-Powered Personalized Learning Platforms on the Academic Achievement and Motivation of Computer Science Senior Secondary School Students in Abuja Municipal Area Council (AMAC) FCT-Abuja, Nigeria

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Article History
Received: 27.07.2024
Accepted: 04.09.2024
Published: 10.09.2024

Abstract: This study investigated the impact of AI-Powered Personalized Learning Platforms on the Academic Achievement and Motivation of Computer Science senior secondary school students in Abuja Municipal Area Council (AMAC) FCT-Abuja, Nigeria. The study raised two research questions and two corresponding hypotheses which were tested at 0.05 level of significance. The study adopted a mixed research method; of both the quasi-experimental design and descriptive survey research design. The population of the study comprised all the public senior secondary school students in Abuja Municipal Area Council (AMAC), Federal Capital Territory (FCT). A sample of 100 students was selected through a combination of purposive and simple random sampling techniques for the study. The researchers adopted Code.org as a treatment instrument while the instrument for data collection was a researchers' designed Computer Achievement Test (CAT) and Motivation Based Questionnaire (MBQ). A draft of the questionnaire was validated through expert judgment involving three lecturers. This was done to establish the face and construct validity. The reliability of the instrument was established through a test-re-test method. A reliability co-efficient of 0.85 and 0.80 was established for both instruments (CAT & MBQ). The data collected were analysed by using independent t-test statistics to test the two formulated hypotheses. The results indicated that Code.org significantly improved the academic achievement of secondary school students compared to traditional learning methods. Furthermore, Code.org positively impacted the motivation of secondary school students. The study recommended amongst others that schools should adopt AI-powered personalized learning platforms such as Code.org for teaching and learning.

Keywords: Artificial Intelligence, Personalized Learning Platforms, Computer Science, Academic Achievement, Motivation, FCT, Nigeria.

INTRODUCTION

Computer science is defined as the study of computers and computational systems, including their principles, algorithms, software, hardware, and applications, and the impact of computing on society (University of Maryland, n.d). It encompasses a broad range of topics, from theoretical foundations to practical implementations, aiming to understand and

utilize computing technology to solve complex problems efficiently (Tucker, 2014). Computer science education in secondary schools in Nigeria refers to the structured curriculum and instructional practices aimed at teaching students about computing concepts, programming languages, algorithms, and the practical application of computer technology. It is designed to equip students with foundational knowledge and skills in computational thinking and problem-solving using computers (Okebukola, 2013). This education typically includes both theoretical understanding and hands-on experience with software and hardware, preparing students for future careers in technology-related fields (Jamil & Isiaq, 2019).

A major aspect of computer science is Programme development. Programme development in web development refers to the process of creating and maintaining software applications that run on web browsers or servers. It involves designing, coding, testing, and debugging web applications to ensure functionality, usability, and security (Kuhail *et al.,* 2021). Web development encompasses both client-side scripting (e.g., HTML, CSS, JavaScript) and server-side scripting (e.g., PHP, Python, Ruby). Client-side scripting focuses on creating interactive user interfaces and experiences directly within web browsers, while server-side scripting involves managing server interactions and databases to support dynamic web content. Programme development in web development is essential for creating responsive and interactive websites, web applications, and e-commerce platforms that meet modern usability and performance standards (RRafiq *et al.,* 2021).

The poor academic performance of students in computer science, particularly in web development, as reflected in West African Examination Council (WAEC) and National Examination Council (NECO) examinations, remains a significant concern in Nigeria. Studies by Amadi & Nwogu (2013) have identified challenges such as inadequate infrastructure, insufficient qualified teachers, and outdated curriculum as primary contributors to this issue. These examinations assess students' grasp of programming languages, algorithms, and practical applications, consistently revealing disparities in achievement levels among schools (Olaleye & Oyediran, 2018). Efforts to address these challenges often focus on curriculum reform, teacher training, and investment in educational technology to enhance learning outcomes (Babatunde, 2016; Olaniyan, 2019). The lack of adequate infrastructure, including insufficient computer laboratories and unreliable internet access, hinders hands-on practical learning essential for understanding complex web development concepts (Oluwatayo, 2015). Additionally, the quality and training of teachers in computer science are crucial; educators lacking adequate training may struggle to effectively deliver curriculum content and impart practical skills (Adeyanju, 2016).

Additionally, outdated curriculum and pedagogical methods that do not align with current industry standards or engage students effectively contribute to the problem (Afolabi & Kupolati, 2015). Student attitudes and motivation towards computer science subjects also play a significant role; low interest and motivation can lead to disengagement and reduced effort in learning (Ijaduola, 2017). Moreover, challenges related to examination standards and preparation, including inadequate adaptation to exam formats and insufficient readiness for standardized tests like WAEC and NECO, further impact academic performance (Olaleye & Oyediran, 2018).

Efforts to address poor academic performance in computer science, despite persistent challenges, have led educators and policymakers to explore innovative solutions such as AI-powered personalized learning platforms. Traditional approaches, including curriculum reforms, teacher training initiatives, and improvements in infrastructure, have shown varying degrees of effectiveness but often struggle to fully engage and meet the diverse needs of students (Babatunde, 2016; Olaniyan, 2019). AI-powered personalized learning platforms offer promising avenues for enhancing educational outcomes. These platforms can adapt to individual learning styles and pace, providing tailored instruction that addresses specific gaps in understanding. By leveraging AI algorithms, these platforms can analyze student performance data in real-time, offering immediate feedback and personalized recommendations for further learning (Koedinger & Corbett, 2012). This personalized approach has the potential to increase student engagement, motivation, and ultimately, academic achievement (Huang, Liu, & Tlili 2019). Furthermore, AI platforms can supplement traditional teaching methods by offering interactive and gamified learning experiences that make complex concepts more accessible and enjoyable for students (Vygotsky, 1978). These technologies can also support teachers by providing insights into student progress and areas needing improvement, enabling more targeted instructional interventions (Picard & Papert, 1990).

Artificial Intelligence (AI) refers to machines' ability to perform tasks typically requiring human intelligence, such as understanding natural language, recognizing patterns, and learning from experience (Mondal, 2020). AI has become increasingly popular

in educational technology, transforming how educators and students engage with learning materials. AI-driven platforms can analyze large volumes of data to provide insights into student learning behaviors and to customize learning experiences (Ouyang & Zhang, 2024). Personalized learning platforms, driven by AI, tailor educational content to individual student needs, pacing, and learning styles (Ayeni, Hamad, Chisom, Osawaru & Adewusi 2024). These platforms aim to enhance academic outcomes by offering adaptive learning paths, instant feedback, and personalized recommendations. By analyzing student performance data, AI-based systems can identify areas where students need additional support, providing targeted exercises and resources to address learning gaps (Murtaza, Ahmed, Shamsi, Sherwani & Usman 2022).

Code.org is a platform dedicated to teaching computer science and coding, offering personalized learning experiences to students (Barradas, Lencastre, Soares & Valente, 2020). Although its primary focus is on programming, it employs adaptive techniques to tailor learning paths based on individual needs, helping to address academic achievement while meeting students where they are. The platform provides a variety of courses that adapt to the pace and skill level of each student, allowing them to progress through lessons at their own speed. This flexibility is central to Code.org's personalized approach, ensuring that students are neither overwhelmed nor bored. By offering this adaptive learning model, Code.org creates a more individualized experience that caters to diverse learning styles and speeds. Code.org's curriculum is comprehensive, spanning from basic coding concepts to advanced topics like artificial intelligence and app development. This broad range of topics allows educators to customize the learning journey according to specific academic goals or student interests. The interactive nature of the platform—featuring puzzles, games, and other engaging activities—provides real-time feedback to students, reinforcing learning and maintaining their interest.

For educators, Code.org offers a wealth of resources, including lesson plans, tutorials, and classroom management tools (Kale & Yuan, 2021). These resources support teachers in crafting personalized learning experiences and providing targeted assistance to students. The platform's progress-tracking and assessment tools enable educators to monitor individual achievements and identify areas where additional guidance is needed, enhancing the platform's adaptability. Code.org also emphasizes inclusivity and accessibility, making its courses available to a wide range of age groups and skill levels. This inclusivity aligns with the goal of providing personalized learning opportunities to as many students as possible. By being accessible and flexible, Code.org can help teachers create learning environments that respect individual differences while promoting academic achievement (Dilmen & Uğraş 2023). Hence, the study aims to investigate the impact of ai-powered personalized learning platforms on the academic achievement and motivation of computer science senior secondary school students in Abuja Municipal Area Council (AMAC) FCT-Abuja, Nigeria.

Statement of the Problem

As educational systems strive to meet the diverse needs of students, personalized learning has emerged as a promising approach to improve academic outcomes and student engagement. However, traditional teaching methods often fail to accommodate individual learning styles, pacing, and unique educational needs, leading to a one-size-fits-all model that can leave some students behind. The increasing use of artificial intelligence (AI) in educational technology offers new opportunities to create personalized learning experiences. AI-powered platforms can adapt content, provide real-time feedback, and track student progress, potentially enhancing academic performance and motivation. Despite these advancements, there is limited empirical evidence on the impact of AI-based personalized learning platforms on student achievement and psychological well-being.

This lack of research raises several critical questions:

1. How does Code.org affect academic achievement of secondary school students?
2. What is the impact of Code.org on motivation of secondary school students?

This study seeks to fill this gap by examining the impact of ai-powered personalized learning platforms on the academic achievement and motivation of computer science senior secondary school students in AMAC FCT-Abuja, Nigeria.

Hypotheses

H01: Code.org do not significantly improve academic achievement of secondary school students compared to traditional learning methods.

H02: Code.org do not positively impact motivation of secondary school students.

METHODOLOGY

The study employed a mixed research methodology, combining both quasi-experimental and descriptive survey designs. This approach was selected to gather both quantitative and qualitative data from the respondents. The population under study encompassed all senior secondary school students in the AMAC, FCT-Abuja. Specifically, the

target population consisted of second year senior secondary school (SSII) students attending public senior secondary schools within AMAC, FCT-Abuja. A sample size of one hundred (100) students was obtained using a two-stage sampling technique. In the first stage, two senior secondary schools were purposively selected based on resource availability, accessibility, and willingness of school administrations to participate in the study. Intact classes within these schools were included in the sample. The schools were then randomly assigned to either the experimental or control group. Government Secondary School Gwarimpa was designated as the experimental group, while Government Secondary School Lugbe served as the control group (see to Table 1).

Table 1: Sample Distribution

S/N	Groups	Schools	Sample
1	Experimental	Government secondary school Gwarimpa	45
2	Control	Government secondary school Lugbe	55
Total			**100**

The researchers adopted the Code.org platform as the treatment instrument (see Fig. 1), which served as the AI-powered personalized learning intervention for the experimental group. Concurrently, the researchers developed two primary instruments: the Computer Achievement Test (CAT) and the Motivation Based Questionnaire (MBQ).

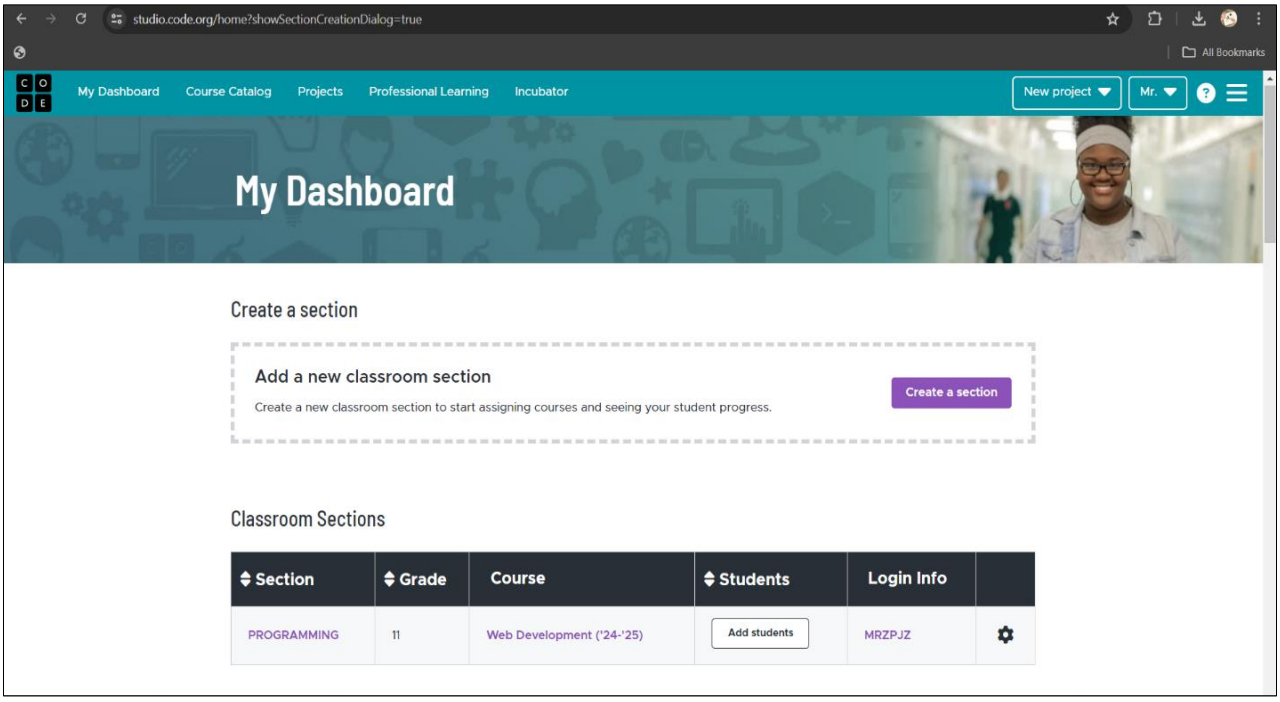

Figure 1: Code.org Personalized Learning Platform

The CAT comprised twenty multiple-choice questions drawn from the WAEC syllabus for Computer Sciences, specifically focusing on the topic of "Program Development". This test was designed to assess students' knowledge and understanding in this area. The MBQ included two sections: Section A collected biographical data from the respondents, while Section B gathered responses regarding the motivation levels of the learners towards the AI-powered personalized learning platform. Both instruments were administered at both the pre-test and post-test stages to gauge changes in knowledge and motivation over time. To ensure the validity and reliability of these instruments, expert judgment involving three lecturers—representing Computer Science, Educational Technology, and Educational Psychology—was sought. This process aimed to establish both face and construct validity. Additionally, the reliability of the instruments was verified through a test-retest method conducted within a three-week interval with students not involved in the main study. The Cronbach alpha coefficient was used to assess reliability, yielding scores of 0.85 for the CAT and 0.80 for the MBQ, indicating strong internal consistency. Data collection involved administering the pre-tests (CAT and MBQ) to both the experimental and control groups before the start of instruction. Following the

teaching and learning period, the post-tests were conducted. The experimental group received instruction using the Code.org platform, primarily online through the computer laboratory at Government Secondary School Gwarimpa (GSS Gwarimpa). In contrast, the control group received traditional instruction using the "chalkboard" method. Both the CAT and MBQ were again administered at the post-test stage to assess changes in knowledge and motivation between the experimental and control groups. The data collected from these instruments were subjected to statistical analysis using independent t-tests to evaluate the formulated hypotheses regarding the impact of the AI-powered personalized learning platform on students' academic achievement and motivation.

RESULTS

H01: Code.org do not significantly improve academic achievement of secondary school students compared to traditional learning methods

Table 2: t-test analysis of the achievement scores of experimental and control groups

Group	N	Mean Post-Test Score	Standard Deviation	t-value	p-value
Experimental	45	16.32	2.83	3.75	0.00
Control	55	13.98	3.15		

Table 2 reveals the mean post-test score for the experimental group was 16.32 with a standard deviation of 2.83, while the mean post-test score for the control group was 13.98 with a standard deviation of 3.15. The independent t-test comparing the post-test scores of the two groups yielded a t-value of 3.75 and a p-value of 0.00. The p-value of 0.00 is less than the significance level of 0.05, indicating that the difference in post-test scores between the experimental and control groups is statistically significant. Therefore, we reject the null hypothesis and conclude that Code.org significantly improves the academic achievement of secondary school students compared to traditional learning methods.

H02: Code.org do not positively impact motivation of secondary school students compared to traditional learning methods.

Table 3: t-test analysis of the motivation scores of experimental and control groups

Group	N	Mean Post-Test Score	Standard Deviation	t-value	p-value
Experimental	45	4.1	0.7	4.23	0.00
Control	55	3.5	0.8		

Table 3 reveals the mean post-test motivation score for the experimental group was 4.1 with a standard deviation of 0.7, while the mean post-test motivation score for the control group was 3.5 with a standard deviation of 0.8. The independent t-test comparing the post-test motivation scores of the two groups yielded a t-value of 4.23 and a p-value of 0.00. The p-value of 0.00 is less than the significance level of 0.05, indicating that the difference in post-test motivation scores between the experimental and control groups is statistically significant. Therefore, we reject the null hypothesis and conclude that Code.org positively impacts the motivation of secondary school students.

DISCUSSION

The experimental group using Code.org demonstrated a mean post-test score of 16.32, significantly higher than the control group's mean post-test score of 13.98. This suggests that AI-based platforms can provide tailored educational experiences that effectively enhance learning outcomes. These findings are consistent with research by Kulik and Fletcher (2016), who reported that computer-based instruction generally results in higher academic performance compared to traditional methods.

Similarly, the study found that the experimental group showed a higher mean post-test motivation score of 4.1 compared to 3.5 for the control group. The significant p-value of 0.00 indicate that increase in motivation can be attributed to the engaging and interactive nature of AI-based educational tools. These results echo findings by Huang *et al.,* (2019), who found that students using AI-driven learning tools reported higher levels of engagement and motivation.

CONCLUSION

Integrating AI-based platforms like Code.org into the curriculum can lead to substantial improvements in both academic performance and student motivation. This can be particularly beneficial in under-resourced educational settings where personalized instruction is difficult to achieve through traditional methods. In education, AI enables personalized learning experiences by tailoring instruction to meet individual student needs, fostering engagement through interactive and gamified elements, and providing immediate feedback to help students track their progress and areas needing improvement.

Recommendations

1. Schools should adopt the use of AI powered personalized learning platforms for teaching and learning.
2. Future research should explore the long-term effects of AI-based educational tools on student outcomes and investigate how these tools can be integrated with traditional teaching methods to maximize benefits.
3. Additionally, studies should examine the impact of AI on different demographic groups to ensure that these technologies are equitable and accessible to all students.
4. Further researchers should also explore the specific features of AI platforms that are most effective in enhancing learning and motivation, providing insights into how these tools can be optimized for educational use.

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