



Artificial Intelligence Tools of Personalized Learning and Intelligent Tutoring System as Correlates of Students Motivation in Chemistry

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Abstract

The study investigated personalized learning and intelligent tutoring system as correlates of students' motivation in chemistry. Two hypotheses were formulated to guide the study. Survey research design was employed for the study. The instrument was "Artificial Intelligence Student Motivation Questionnaire" (AISMQ). A sample of 200 students was selected using a simple random sampling technique. Two hypotheses were tested using Pearson Correlation analysis at 0.05 level of significance. The findings reported that both, personalized learning and intelligent tutoring system was significant. Hence, it was recommended among others that students be taught on how to use personalized learning and intelligent tutoring system.

Keywords; Artificial Intelligence, Intelligent Tutoring System, Personalized Learning, Students Motivation,

Introduction

Chemistry is the study of matter and its' properties (Weiss, 2019). It is a central science because it connects many other scientific disciplines. The foundation for much technological advancement that improves human lives are provided by chemistry. Chemistry is critical for the development of the world. If there is the desire to produce the next generation of scientists and innovators that will acquire careers in STEM fields and prepare students, chemistry as a subject of study is very crucial for the challenges of the future (Kirchhoff, 2017). Chemistry students in many schools have low motivation in the study of chemistry because they perceive that the subject is abstract and as such very difficult to comprehend (Cooper et al. 2019; Nja et al 2024). There is therefore the need to teach chemistry in such a way that will take away this perceived fear and get them motivated to learn.

Ryan and Deci(2013), defined students' motivation as the drive or desire that students have to learn and achieve academic goals. Students' motivation can also be said to be the propellant that propels learning in the absence of which students may struggle to; engage in academic tasks, persist in the face of challenges, and achieve less in

academic goals (Svinicki, 2014). Students' motivation is a very important factor when academic success is to be examined. Despite that, it is a common problem that students lose motivation over time. Reasons for this low motivation can be attributed to factors like; the boring nature of chemistry, a perceived lack of relevance to their life outside of the classroom (Hrabowski II, 2016). Providing students with real-world experiences and context for learning chemistry can help to increase their motivation to engage in the subject (Hoffman & Cooper, 2014). Shute et al. (2016) study reported that the use of artificial intelligence in Educational settings has the potential to increase students' motivation.

Artificial Intelligence (AI) refers to a computer programs that mimic the way human brain functions and man's intelligence (Huanget al., 2019; Nja et al 2023a). There are various forms of Artificial intelligence-based systems which include Chatbots, AI-powered Gamification, Intelligent Tutoring Systems and Personalized Learning. These AI can play a vital role in enhancing learners' motivation through the provision of individualized and adaptive learning experiences, on-the-spot feedback and opportunities for self-directed learning, that are directed to the specific needs and



interests of individual students (Tang et al., 2019; Nkereuwem, et al 2023). Personalized learning is a teaching method that tailors learning experiences to each student's individual needs, strength, weaknesses and interests (Samad et al., 2022). On the other hand, An intelligent tutoring system is a computer-based system that uses artificial intelligence to provide personalized instruction, guidance and feedback to learners based on their performance data (Graesser et al., 2018). The goal of an intelligent tutoring system is to facilitate efficient and effective learning by adapting to the learners, cognitive and affective states as well as by providing tailored content, pedagogy and assessment. (Hockenberry et al., 2019).

The benefits of using artificial intelligence in education is significant as it can enhance both intrinsic and extrinsic motivation (Nja et al., 2023b). Therefore, this study sought to explore the potential of an artificial intelligence-based educational system on students' motivation.

Theoretical Framework

This study is theoretically framed on Flow Theory. The flow theory was propounded by Mihaly Csikszentmihalyi in 1975. According to this theory, Flow is a state of complete immersion and involvement in an activity where one's skills and abilities are well-matched to the challenge of the activity. Flow occurs when three conditions are met: clear goals, immediate feedback and a balance of skills and challenge. Flow can be hindered by activities that are too easy or too difficult.

According to the flow theory, students become highly motivated and engaged in their learning activity when they have clear goals or objectives to guide their actions, receive immediate feedback about their progress and performance and also balance their skills and challenges.

AI-based educational systems support flow theory by adjusting the Challenge level of learning activities based on learners' performance and skills level, providing immediate feedback and guidance to learners as they work through learning activities, also by using a game-based learning technique to make learning activities more engaging and enjoyable for learners.

Statement of the Problem

In an ideal situation, all students would be highly motivated to learn and engage in academic activities. However, in the present situation, many students are lacking motivation in their academic pursuits. Also, there seems to be a lack of active participation and genuine excitement for learning. This trend is troubling because it can lead to lower academic performance, decreased interest in learning, hinders students' ability to fully grasp and retain information. It can also lower self-esteem and confidence in academic pursuits.

To address this problem, it is necessary to explore the relationship between personalized learning and intelligent tutoring systems, and students' motivation in chemistry. This involves understanding how AI can be leveraged to adapt instructional strategies to individual student needs and provide real-time feedback and support to foster a sense of accomplishment.

Hypothesis

Two null hypotheses were stated to guide the study:

1. Personalized learning does not have a significant relationship with students' motivation.
2. There is no significant relationship between an intelligent tutoring system and student motivation.

Literature Review

Personalized Learning and Student Motivation

Personalized learning involves individualizing education through learner-centered approaches. It focuses on adapting instruction to students' strengths, weaknesses, and learning styles, fostering autonomy and engagement. (Pane et al., 2015). A review of research by U.S. Department of Education (2010) on the impact of technology on student motivation highlighted that personalized learning approaches can enhance student motivation by providing choices, autonomy, and opportunities for self-directed learning. Personalized learning allows students to progress at their own pace, with customized learning paths based on their readiness, interests, and prior knowledge. Personalized learning Technology plays a crucial role in enabling adaptive learning platforms that provide tailored content and assessments (Dabbagh & Kitsantas,



2012). Research suggests that personalized learning can lead to improved academic performance, increased motivation, and enhanced critical thinking skills. It also supports students' social-emotional well-being, fostering a positive learning environment. (Pane et al., 2017).

Findings revealed that personalized learning, including individualized goals, pacing, and feedback, positively influenced student motivation, leading to increased effort and engagement Murray et al. 2017; a significant positive relationship between personalized instruction and student motivation (Huett et al., 2008) emphasized the importance of students' active involvement and ownership in their learning process (Hattie et al., 2012).

These studies and research reviews collectively indicated that personalized learning approaches positively impact student motivation by fostering engagement, autonomy, and a sense of ownership in the learning process. It suggests that when students feel that their learning experiences are tailored to their individual needs, interests, and abilities, they are more likely to be motivated and actively engage in their education.

Intelligent Tutoring System and Student Motivation

An intelligent tutoring system (ITS) is a computer-based instructional system that provides personalized and adaptive instruction to students, emulating the role of a human tutor. It uses artificial intelligence and machine learning techniques to assess the student's knowledge, deliver targeted feedback, and dynamically adjust the learning materials and activities based on the student's individual needs and progress (Woelf, 2009).

Intelligent tutoring systems can have a positive impact on student motivation by dynamically adapting the learning environment based on the student's affective states. By recognizing and responding to the student's emotional and motivational cues, the system can provide tailored support and maintain engagement throughout the

learning process (D'Mello & Graesser, 2012). Roll and Winne (2015) emphasized the role of self-regulated learning (SRL) in intelligent tutoring systems. Supporting students' development of SRL skills, such as goal setting, planning, and self-monitoring, can enhance their motivation and engagement with the system.

Research Methodology

The research design adopted for this study was a correlational survey. This design was considered appropriate because of its ability to collect data from a large number of respondents efficiently, allowing for generalizability and examination of relationship between variables. (Sarantakos, 2013).

The population of the study comprises of all Chemistry Education Students in the Department of Science Education, University of Calabar in 2021/2022 Academic Session. A random sampling procedure was adopted to select the students per level. A total of 200 students across the four levels which represents 80% of the population of 251 students were sampled for use in the study.

A questionnaire titled 'Artificial Intelligence and Student Motivation Questionnaire' (AISMQ) was the instrument used in this study for data collection. It consisted of 15 items to which respondents were meant to indicate their level of agreement or disagreement based on the four points likert-type scale. Face and content validity was carried out on the instrument. To ensure the content validity of the instrument, a table of specification was developed to ensure that the sub-topic with much items had more items on the questionnaire than those with fewer contents. The reliability of the research instrument was done using the Cronbach alpha reliability method. The reliability coefficients was 0.7 and 0.83. The questionnaire was administered online to the 200 students by sharing a link (<https://forms.gle/1wsjfaxhWGqaWCvVA>) to them, through the WhatsApp platform.



Results

Table 1

Pearson Correlation coefficient between personalized learning and student motivation (SPSS 22) N=200

Correlations			
VARIABLES		PERSONALIZED	MOTIVATION
PERSONALIZED	Pearson Correlation	1	.548**
	Sig. (2-tailed)		.000
	N	200	200
	Pearson Correlation	.548**	1
MOTIVATION	Sig. (2-tailed)	.000	
	N	200	200

*(P .05) Df=198; calculated r= .548

The result of the analysis as presented in Table 1 shows that the calculated r-value was .548 at 198 degree of freedom and a p-value of .000 at 0.05 level of significance. The p-value of .000 was lower than the significant value of .05 ($P < .05$) needed to

make a decision. With this result, the null hypothesis was rejected and the alternate hypothesis was accepted. This implies that personalized learning is significantly related to student motivation.

Table 2. Pearson Moment Correlation coefficient between Intelligent tutoring system and student motivation (SPSS 22) N=200

Correlations				
Variables			Intelligent monitoring system	Motivation
Intelligent monitoring system		Pearson Correlation	1	.662**
		Sig. (2-tailed)		.000
		N	200	200
		Pearson Correlation	.662**	1
MOTIVATION		Sig. (2-tailed)	.000	
		N	200	200

*(P .05) Df=198; calculated r= .662

The result from Table 2 shows that the calculated r-value was .662 at 198 degrees of freedom and a p-value of .000 at a 0.05 level of significance. The p-value of .000 was lower than the significant value of .05 ($P < .05$). Therefore, the null hypothesis was rejected while the alternative hypothesis was accepted. This implies that there is significant relationship between Intelligent tutoring system and student motivation.

Discuss of Findings

The discussion of the findings that emerged from the analysis are presented. The discussion is presented hypothesis by hypothesis. The first hypothesis states that, there is no significant relationship between Personalized learning and student motivation. The result from the data

analysis reported a significant relationship between personalized learning and students' motivation. Personalized learning is significantly related to student motivation by tailoring educational experiences to individual students' needs, preferences, and learning styles. When students are able to engage with material that aligns with their interests and abilities, they experience a sense of ownership and relevance in their learning journey. This fosters a greater sense of autonomy and control, as they perceive themselves as active participants in their education rather than passive recipients. As a result, students are more likely to stay engaged, set higher goals, and take responsibility for their learning outcomes, ultimately boosting their intrinsic motivation.



The findings of this hypothesis is in line with a survey-based study by Huett et al. (2008) which investigated the effects of personalized learning on student motivation and found a significant positive relationship between personalized instruction and student motivation. The finding also agrees with the study conducted by Pane et al. (2015) which examined the effects of personalized learning on student motivation. The research found that students in personalized learning environments reported higher levels of motivation, engagement, and self-efficacy compared to traditional classroom settings.

The second hypothesis states that, there is no significant relationship between Intelligent tutoring system and student motivation. The result from the data analysis of hypothesis two showed that, there is significant relationship between intelligent tutoring system and student motivation. Intelligent Tutoring Systems (ITS) have a profound influence on student motivation by offering personalized and adaptive learning experiences. These systems utilize advanced algorithms and AI to assess a student's knowledge, skills, and learning pace, tailoring the content and challenges accordingly. The immediate feedback and customized guidance provided by ITS offer a sense of mastery, boosting students' confidence and intrinsic motivation. As students witness their progress in real time and receive targeted support to overcome challenges, they feel empowered and engaged, leading to a greater investment in their learning journey.

The findings of this study is in line with Roll and Winne (2015) which stated that self-regulated learning (SRL) skills, such as goal setting, planning, and self-monitoring in intelligent tutoring systems enhances student motivation and engagement. The findings also agree with Paquette and de la Teja (2014) who stated that intelligent tutoring systems can provide motivational feedback tailored to the individual learner, promoting a sense of competence, autonomy, and relatedness. By offering positive reinforcement, goal-setting guidance, and progress monitoring, these systems can enhance student motivation and self-efficacy.

Conclusion

This study concluded that personalized learning and intelligent tutoring systems enhanced students' motivation in the study of chemistry concepts.

Recommendations

From the findings of the study, it was recommendations that:

1. Collaboration between teachers and AI systems should be encouraged to leverage the strengths of both the intelligence tutoring systems and personalized learning, through the provision of adequate AI or ICT facilities and teachers' training necessary for the use of such technologies in learning
2. Incorporate AI technologies that can provide emotional support and facilitate social interaction among students. This can be done through natural language processing by providing students with personalized and empathetic support. With that, students engaged in conversations about their emotions helping them identify and understand their feelings

Suggestion for Further Studies

The following suggestions were made for further studies:

A study should be carried out using a larger sample size to promote more generalization of findings. The study should be carried out in other local Government areas in Cross River State Nigeria

A study of this nature with other AI-based systems like Chatbots and AI-powered Gamification, should be conducted.

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