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THEME:

RE-THINKING THE FUTURE THROUGH STEM AND TVET FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS

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EFFECTS OF MOODLE PLATFORM-ENHANCED INSTRUCTION ON MOTIVATION AMONG CHEMISTRY UNDERGRADUATE STUDENTS IN TARABA STATE UNIVERSITIES, NIGERIA

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Abstract
This study investigated the effects Moodle Platform-enhanced instruction on motivation among chemistry undergraduate students in Taraba state universities. A Quasi-Experimental Pre-test, Post-test, Non-equivalent and Non-randomized groups Design was adopted. Two research questions and two research hypotheses were formulated for the study. Purposive sampling technique was adapted for the study. The sample size consists of 295 second year Chemistry universities students drawn from two Universities from Taraba State, Nigeria using an intact class, one school was assigned experimental group and the other as control group respectively. A validated Chemistry motivational inventory Scales (CMIS) was used. Cronbach alpha was used to determine the reliability of the instrument and the coefficient was found to be0.83. Data collected for CMIS was analyzed using mean rank and sum of rank to answer research question while Mann Whitney and Kruskal-Wallis were used to test the hypotheses at 0.05 alpha level of significance. The study revealed that students taught chemistry using Moodle platform enhanced instruction had significantly higher mean motivation scores than those taught using lectures method (N=295, U_{value} 5966.0, P_{value} 0.00<0.05). There was a significant difference in the mean motivation scores of male and female student in experimental and control group (N=295, df= 3 H_{value} 32.87, P_{value} 0.00<0.05). Based on the findings of the study, it was recommended among others that Universities should implement the use of Moodle platforms enhanced instruction in teaching and learning process for the purpose of developing positive motivation in students and Moodle platform should be used on single sex to improve their motivation in chemistry.

Keywords: *Motivation, Moodle Platform-enhanced instruction and Undergraduate Students.*

Background to the Study

Science education can be defined as the study of physics, chemistry, biology and Mathematics with teaching method in order to impart scientific knowledge to individuals or community. It is a field of specialization concerning with two basic aims, which are the production of scientifically interactive society and technological manpower. Science education in the area of academic and industrial activity is the backbone of industrialization and development of any nation. The science related disciplines that will enable the learner to have true knowledge of science and to be able to use it in solving problem are Physics, Chemistry, Biology and Mathematics. Science education are school subject that play an important role in life, they are important because they are the basic subject for the development of many study fields such as mechanical engineering, electronics, nuclear sciences, medicine and surgery, medical laboratory sciences, pharmacy and digital information system. Science education presents various problems, from the simplest to the complex ones, as well as from the macro to the micro ones. Science education contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries (Saifullahi, 2021). It plays a major role in the area of health, economic development, energy and environment etc as much in chemistry.

To achieve and create valuable teaching e-learning environments, these learning management system platforms have provided students and teachers with better approaches to the teaching and learning processes that could enhance students' motivation (Sobowale *et al., 2019;* Gambari, *et al.,*2019). This calls for an examination of the effect of the Moodle platform on students' motivation in chemistry among undergraduate students using the Moodle platform. This platform has many capabilities, provided that they are used to their fullest. For example, interaction, feedback, conversation, and networking are some of the possible actions using the learning platforms. Furthermore, they provide a lot of opportunities to explore new methods of teaching and learning (Costa, *et al.,* 2012; Safiyeh, 2015),

which support a number of activities for course creation, administration, and delivery of lectures, as well as facilities for communication between participants through sharing information on a Moodle site.

Motivation is an internal drive that spurs one into action (Tus, 2020). It is an important psychological construct that drives a person's actions. Motivation is a strong desire or passion in a person that encourages the person to try and do something in order to succeed. Motivation affects student learning and plays an important role in directing behavior towards a certain goal, increasing effort and energy towards a goal, increasing the initiative and perseverance of an activity, and improving individual performance. Teaching science in a fun and effective manner will increase students' motivation to learn science (Saifullahi, 2021). They believe that if teachers give suitable feedback to the students on their level, initiate students' interest, make them understand the importance of the content, and have students share their ideas in classroom discussion, then the student's motivation increases as well as their achievement. Student effort toward academic achievement is controlled by motivational factors such as interest, competence, and autonomy. Gambari *et al.* (2018) opined that motivation is a state of empowerment with physiological, cognitive, and affective dimensions that makes individuals energized for a certain goal. It is also the willingness to perform an action, increasing eagerness to work, directing efforts, and directly affecting the performance of workers. It is an inner state that stimulates and triggers behavior. The two main sources of motivation identified by Gambari *et al.* (2016) are intrinsic and extrinsic motivation. Intrinsic motivation is described as the internal desires and willingness to perform a particular task, such as interest, enjoyment, and satisfaction, while extrinsic motivation refers to external factors that move an individual to carry out activities, including rewards, coercion, the threat of punishment, and so on. By applying the Moodle platform to the classroom, students may be motivated to learn in new ways or enjoy otherwise tedious tasks. Feizabadi *et al.* (2016) report that anything that aids learning should improve motivation, while things that lead to confusion or interference among learning materials decrease the speed and efficiency of learning and accelerate forgetting.

Gender inequality in science and science education in general has remained a perennial problem of global scope (Keter, 2018). Gender, according to Sobowale *et al.* (2020), is a socio-cultural construct of ascribing characters and roles to sex, such as males and females. Oludipe (2012), noted that the prevalent effects of gender bias and gender stereotypes in Nigeria affect certain vocations and professions, such that traditional professions like medicine, engineering, architecture, etc. are regarded as belonging to men while nursing, typing, catering, etc. are regarded as belonging to women. The stereotyping bias that science is a male enterprise is of great concern in the field of science education. The nation's quest for science and technological advancement will become a mirage if effective mechanisms are not put in place to incorporate innovative methods that promote active learning. Considering the importance of chemistry in all-round development, there is a need to make sure that chemistry is properly taught using innovative methods such as the Moodle platform.

Statement of the Problem

Chemistry is needed for the sustainable development of any nation, as its knowledge is important in the manufacturing of drugs, fertilizer, insecticides, food processing and storage, the management of our natural resources, the provision of food and health facilities, and a favorable living environment. Chemistry provides a natural link between home and school and is the means through which students understand the world around them and explore the wider implications of science in relation to man. Consequently, the teaching and learning of chemistry are of great concern to educators. Student's performance in the subject has not been satisfactory, and a good number of research efforts have been made to diagnose the problems associated with the teaching and learning of chemistry in order to propose solutions that could lead to better achievement. Among the factors that hinder students' achievement in Chemistry are students' background problems, students' lack of interest and/or negative attitude towards Chemistry; teacher-related factors such as poor teacher preparation, inadequately qualified Chemistry teachers, inadequate qualified Chemistry teachers, inadequate teaching and learning resources and poor teaching methods (Abudu & Gbadamosi 2014;Nur, *et al.,* 2020); lack of motivation (Gambari, *et al.,* 2018); inadequate teaching and learning resources and poor teaching methodologies (John 2017); abstract nature of chemistry (Ojoye *et al.,*2019); and inability of students to grasp the concepts in organic chemistry (Gambari *et al.,*2019). Despite the importance of chemistry

to mankind and the efforts of stakeholders to improve its teaching and learning, the achievement of students in the subject remains low in Nigeria. It is against this background that this study is aimed at finding out the effect of enhanced Moodle Platform instruction on motivation among chemistry undergraduate students in universities in Taraba State, Nigeria.

Aim and Objectives of the Study

Specifically, the objectives of this study sought to achieve the following:

1. To determine the effects of Moodle Platform enhanced instruction on Chemistry students' motivation among undergraduate students in universities in Taraba State,
2. To determine the effects of Moodle Platform enhanced instruction on Chemistry students' motivation based on gender among undergraduates in universities in Taraba State.

Research Questions

The following research questions guided the study:

1. What is the difference in the mean motivation score of students taught chemistry using the Moodle platform and those taught using lecture methods in universities in Taraba State?
2. What is the difference in the mean motivation score between male and female students taught chemistry using the Moodle platform and those taught using lecture methods in Taraba State Universities?

Research Hypotheses

The following null hypotheses are formulated to guide the study:

1. There is no significant difference in the motivation score of students taught chemistry using the Moodle platform and those taught using lecture methods in universities in Taraba State.
2. There is no significant difference in the mean motivation score between male and female students taught chemistry using the Moodle platform and those taught using lecture methods in Taraba state universities.

Theoretical Frameworks

The theoretical framework of this study is built on the constructivist theory of people knowing the world through their framework and helping them to organize as well as interpret their perceptions (Gambari, *et al.,* 2019). Constructivism in learning theory is defined as the active construction of new knowledge based on a learner's prior experience. Constructivism learning theory, which focuses on knowledge construction based on the learner's previous experience, is a good fit for online learning because it ensures learning among learners (John, 2017). A major focus of constructivists is situated learning, which sees learning as contextual. In most pedagogies based on constructivism, the teacher's role is not only to observe and assess but also to engage with the students while they are completing activities, wondering aloud, and posing questions to the students for the promotion of reasoning. Constructivists see learners as being active rather than passive, so they will be at the center of the learning, with the instructor playing an advisory and facilitating role. That will encourage the learner to arrive at his or her version of the truth, influenced by his or her background, culture, or embedded worldview (Keter, 2018).

Learning should be an active process by means of keeping learners active through high-level activities such as asking learners to apply information to practical situations, facilitating personal interpretation of learning content, discussing topics within a group, assessment, and so on (Bello & Abimbola, 2012). The constructivist classroom is an environment in which students will have enough time to develop mental models of the content, which will assist in moving that knowledge away from the primary content area so that it can be applied elsewhere (John 2017). Keter (2018) stated that the teacher is seen as a facilitator of learning, where learners are permitted to move around freely, use of time is flexible rather than structured, and evaluation compares learners to themselves rather than to peers, with a de-emphasis on formal testing. The constructivist classroom should be an environment based on inquiry, which will lead the learners to a deep understanding of the concepts under study. As a theory of learning, constructivism is relevant to this study, as the researcher wished to establish how learners learn using the Moodle platform using the constructivist theory as a framework for the study.

Methodology

The research design for this study is a quasi-experimental research design. Specifically, pre-test, post-test, non-equivalent, and non-randomized groups The design is considered suitable for this study since intact classes were used to avoid disruption of normal class lessons or activities (Gambari, *et al.,* 2019). The population for this study comprised 1198 chemistry students drawn from all the universities in Taraba State for the 2021/2022 academic session. However, a target population of 200-level undergraduate chemistry students at the two universities was used. A purposeful sampling technique was used to select the two universities. An intact class of two hundred ninety-five (295) undergraduate university students was selected for the study, consisting of one hundred and forty-six (146) males and one hundred and forty-nine (149) females.

The instruments used for data collection were Moodle Platform (MP) and the Chemistry Motivation Inventory Scale (CMIS), which were designed by the researcher. It consists of two sections. Section A dealt with the gender of the students. Section B consists of 25 positive motivational statements that are measured on a four-point Likert-type rating scale. The four-point Likert-type rating scale was used to enable students to indicate their level of motivation as follows: HM = highly motivated (4) M = motivated (3), MM = moderately motivated (2), and NM = not motivated (1) were positively scored. The instruments were validated by three experts in the Department of Science and Technology Education, Federal University of Technology, Minna, Niger State, which gives a reliability coefficient of **0.83** using Cronbach's alpha. The mean rank and sum of rank were used to answer the research questions, while the hypotheses were tested at a 0.05 alpha significance level using the Mann-Whitney test and the Kruskal-Wallis test using SPSS version 26.

Results

Research Question One: What is the difference in mean motivation score of students taught chemistry using Moodle Platform and those taught using lecture methods in universities in Taraba State?
To answer this research question mean rank and sum of rank was used and is presented in Table 1.

Table 1: Analysis of Mean rank and Sum of Rank Motivation Scores of Students taught Chemistry using Moodle Platform and those taught using Lectures Method

Group	N	Mean Rank	Sum of Rank	Mean Rank Difference
Moodle Platform	124	185.39	22988.00	
				64.50
Lecture Method	171	120.89	20672.00	

Table 1 reveals the analysis of the mean rank and sum rank of motivation scores of students taught chemistry using the Moodle platform and those taught using the lecture method. The mean rank scores for the experimental and control groups were 185.39 and 120.89, respectively, with a sum of ranks of 22988.0 and 20672.0, respectively. However, the mean rank difference for both groups is 64.50 in favor of the Moodle platform-enhanced instruction. Thus, there is a difference in the mean motivation scores between the experimental and control groups in favor of the experimental group. This indicates that Moodle platform group students' motivation capacity is higher than that of a lecture method in chemistry.

Research Question Two: What is the difference mean motivation score between male and female students taught chemistry using Moodle Platform and those taught using lecture methods in Taraba state universities?

To answer this research question mean rank and sum of rank was used and is presented in Table 2.

Table 2: Analysis of Mean rank and Sum of Rank Motivation Scores of male and female Students taught Chemistry using Moodle Platform and those taught using Lectures Method

Group	**N**	**Mean Rank**	**Sum of Ranks**	**Mean Rank Difference**
Moodle Platform				
Male	56	55.41	3103.00	
				12.98
Female	68	68.34	4647.00	

Lecture Method				
Male	90	89.77	8079.00	7.96
Female	81	81.81	6627.00	

Table 2 reveals the analysis of the mean rank and sum of rank motivation scores of males and females in the experimental and control groups. Males and females in the experimental group had mean rank scores of 55.41 and 68.34, with sums of rank of 3103.0 and 74647.0, respectively. The mean rank difference between male and female students in the experimental group is 12.98 in favor of female students. Males and females in the control group had mean rank scores of 89.77 and 81.81, with a sum of rank of 8079.0 and 6627.0, respectively. The mean rank difference between males and females in the control group is 7.96 in favor of the male students. Thus, there is a difference in the mean motivation scores between male and female students in both groups.

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Hypothesis One: There is no significant difference in the mean motivation score of students taught chemistry using Moodle Platform and those taught using lecture methods in universities in Taraba State.

Table 3: Analysis of Mann-Whitney U-test for Posttest Mean Rank of Motivation Scores of the Experimental and Control Group

Group	N	Mean Rank	Sum of Rank	U-value	P-value	Decision
Moodle Platform	124	185.39	22988.00	5966.0	0.00	Significant
Lecture Method	171	120.89	20672.00			

Table 3 presents an analysis of Mann-Whitney U-test analyses for the posttest mean rank and sum of rank of the experimental and control groups of the mean motivation score of students taught chemistry using the Moodle platform and those taught using the lecture method. The observed P-value is 0.00, and the alpha-value is 0.05 with df = 293. Therefore, the observed P-value is less than the alpha-value, and thus the null hypothesis is hereby rejected and it is concluded that there is a significant difference in the mean motivation score of students taught chemistry using Moodle platform-enhancing instruction and those taught using lecture methods in favor of the experimental group (U=5966.0, df=293 , P=0.00<0.05).

Hypothesis Two: There is no significant difference mean motivation score of between male and female students taught chemistry using Moodle Platform and those taught using lecture methods in Taraba state universities

Table 4: Analysis of Kruskal-Wallis test of Mean Rank Motivation Scores of the Male and Female students taught chemistry using Moodle Platform those taught using lecture methods.

Groups	N	df	H-value	P-value	Decision
Gender	295	3	32.87	0 .00	Significant

Table 4 presents an analysis of the Kruskal-Wallis H-test for the posttest mean rank of male and female students taught chemistry using the Moodle platform and those taught using the lecture method. The observed P-value is 0.00, and the alpha-value is 0.05 with df = 3. Therefore, the observed P-value is less than the alpha-value, and thus the null hypothesis is therefore rejected. It is concluded that there is a significant difference in the mean motivation score of male and female students taught chemistry using Moodle platform-enhancing instruction and those taught using lecture methods (H=32.87, df=3, P=0.00<0.05).

Discussion of Findings

The findings of this study revealed that there is significant difference in the mean motivation scores between students taught Chemistry using Moodle Platform enhanced instruction and those taught using lectures method in favor of Moodle platform. This finding agrees with Ahmed *et al.,* (2020) who found

that students have higher Motivation capacity when they are actively engaged in solving problems through Moodle Platform than when they become passive learners as obtained in the use of traditional method. The likely explanation for this outcome may also be connected to the fact that the use of Moodle Platform in science teaching orient students towards reflecting on, interpreting and searching for solutions to the problems themselves when compared to the Lectures method.

The finding also revealed that there is significant difference in the mean motivation scores between male and female students taught using Moodle Platform in favor of Female students. This finding agreed with the finding of Keter (2018) who found that female students' have higher motivation capacity than their male counterparts in Chemistry and also contradicts the finding of El-Seoud *et al., (*2020) who found that male students' have higher motivation capacity than their female counterparts in Science Education and with the findings of Gambari, *et al.,* (2017) who found no gender disparity in senior secondary students' motivation in Chemistry. However, the likely reason for the agreement of these findings could be that Moodle Platform method enhances greater motivation capacity of female students through lasting comprehension of things they do in comparison with the ones they only see or hear.

Conclusion

Based on the findings of this study it can be concluded that Moodle platform-enhanced instructions are more effective than the lecture method. The researcher inferred that the high mean gains achieved by the Moodle platform is as a result of student–to-student interaction, a flexible environment for online learning, a good alternative for the regular lecture, offers students instant feedback and places an emphasis on practice and mastering the information.

Recommendations

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

1. Workshops, conferences, and seminars should be organized by NUC, the Ministry of Education, and other school administrators on the need for the Moodle platform in the teaching of chemistry in order to enhance students'
2. The Moodle platform should be used by singles to improve their motivation in chemistry

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