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EFFECT OF SCIENCE ANXIETY ON STUDENT'S ENGAGEMENT IN PHYSICS LABORATORY EXPERIMENT: A STUDY OF SENIOR SECONDARY SCHOOL STUDENTS IN ENUGU STATE, NIGERIA

Livinus O. Odo*

Department of Physics Federal College of Education, Eha Amufu

Corresponding Author: -

ABSTRACT

A physics laboratory experiment is an essential component of science learning that positively establishes scientific attitudes and skills in young learners. However, insinuation suggests that most students show less commitment to engaging in a physics lab experiment. Thus, the purpose of the present study was to examine science anxiety as a factor that could predict the variation in students' participation in a physics lab experiment. Two hundred and eleven students who met the inclusion criteria were selected from secondary schools in the Enugu state as the participants. The respondents completed a self-report measure of science anxiety and engagement in a lab experiment questionnaire. The linear regression established a statistically significant effect of science anxiety on the respondent's participation in physics lab experiments at F (1,209), 214.518 P< .05 with adjusted R^2 indicating that science anxiety contributed about 31.1% of the variance in student engagement in a physics lab experiment. Thus, the study concluded that science anxiety positively determines students' participation in a lab experiment.

KEYWORDS: *Science anxiety, physics, laboratory, experiment, students*

BACKGROUND

Physics education holds remarkable potential in providing an outstanding prospect to instigate and govern justifiable development for the future (Nasri et al., 2020). Physics is an indispensable subject in the science domain. It represents a scientific step at the secondary school level, which might predict a real solution towards attaining a scientifically disposed of society capable of projecting the nation towards realizing a sustainable economic force (Aderonmu & Obafemi, 2015). Thus, researchers have argued that physics as a subject might foster high-end cognitive skills, improve the young learner's scientific mastery and proficiencies, and create a strictly literate, The subject is largely used to pique students' interest, curiosity, and desire to understand science, as well as to increase student enrollment in scientific-related courses (Nasri et al., 2020). As a result, physics learning necessitates a greater focus on the teaching and learning process in order to raise students' levels of knowledge and comprehension to the appropriate level (Ali, 2020). Learning physics, according to researchers, generates cognitive processes that handle broad application problems. (Grayson, 2020). Several disparate studies have highlighted the significance of physics (Descamps et al., 2020; Hake, 2011; Hidayatulah et al., 2021; Magazù, 2018; Nair, 2018; Nair & Sawtele, 2019; Zalewski et al., 2019).

Some scholars identified physics as the less-liked subject by science students in Nigeria (Amusa, 2020). Research in Nigeria has reported students' underperformance in Physics (Achufusi et al., 2019). Scholars in science education in Nigeria have consistently sought ways of refining the situation and maximizing the students' expressive learning of physics (Ebong, 2021). Understanding the factors influencing performance in secondary school physics is the first step in resolving the increasing low performance in physics (Onah & Ugwu, 2010). Thus, practical works are mainly instituted to explore individual patterns and identify scientific skills. Indeed, practical experimentation with physics laws and observation of a phenomenon in the laboratory setting increases the learner's scientific ability (Chang et al., 2015).

Laboratory experiments are essential components of secondary school science learning (Sharpe & Abrahams, 2020). Many post-primary curriculums underscore the relevance of experimental practicals in the syllabi of science subjects, including chemistry and physics (Sorgo & Spernjak, 2012). Laboratory practical experiences enable science students to conduct basic experiments on the fundamental laws and principles and gain experience using various measuring instruments and other physics-related apparatus. Experiments enhance basic learning skills (Babalola, 2017). Laboratory experiments in physics reflect learning conducted in a particular context to improve learners' motivation and engagement due to relevant learning occurrences drawn from everyday experiences and phenomena (Stanley, 2000). For physics learning, labs play a very active and significant role. It is essential to acquire basic principles and concepts constantly required to identify hidden ideas and define and explain underlying laws and theories using high-level reasoning skills.

Literatures abound that suggest a link between physics lab experiment with increased interest and motivation, improved performance, and favorable attitudes (Babajide, 2010; Babalola, 2017; Bandele & Owolabi, 2009; Cheung, 2016; Juuti & Lavonen, 2016; Kacovsky & Snetinova, 2021; Lee & Sulaiman, 2018; Naval, 2020; Trivedi & Sharma, 2013; Uba & Mba, 2012; Ukoh & Amuda, 2015). Similarly, empirical evidence implicates physics lab experiments on performance. For instance, Omeodu (2018) investigated the impact of experimental teaching approaches in secondary schools in Rivers State, Nigeria. The respondents in the survey saw physics experimental work as an activity that promotes instructors' and students' comprehension of the topics by assisting them in mastering the information via inquiries and observations. Omeodu (2018) also stated that experimental physics activity makes scientific phenomena more tangible and has a lot of potentials to improve social interactions, which may lead to good attitude development. As a result, Twahirwa and Twizeyimana (2020) evaluated the impact of practical physics practice on academic performance among Rwandan secondary school students. The study adopted a quasi-experimental research design, specifically a pretest-posttest control group design (control group and experimental group). The study disclosed that practical physics work was more effective in improving students' performance in physics. Hence, experimental work remains a fundamental approach to teaching and learning physics.

Amadalo et al. (2016) examined practical work as a predictive variable in learning physics by allowing the participant to conduct empirical investigations. The study utilized two groups of girls from three sampled medium-performing schools in Western Kenya. The experimental conditions were exposed to thorough practical work. The researchers assessed the groups regarding accomplishment on the test, attitude acquired towards physics, and relative choice to further the subject in future classes. The study discovered that the group in the experimental condition performed better than the control conditions. Thus, signifying the relevance of practical work on physics learning.

One study evaluated the effectiveness of practical physics projects on performances and compared gender differences in achievement following the implementation of a practical project in experimental research (Lee & Sulaiman, 2018). The experiment utilized sixty-six students from the Semporna District in Sabah. The study adopted a quasi-experimental design, and their findings showed that practical physics work positively influences physics performance. Musasia et al. (2012) sought to determine the difference in academic accomplishment in physics between students involved in complete practical projects and students taught with the conventional methods. The investigation was conducted in Kakamega South Sub-County-Kenya with a quasi-experimental research design. The authors analyzed their post-test study using independent t-test, ANOVA, and Chi-Square. They found that the experimental condition significantly outperformed the control condition.

Regardless of the benefits of physics lab experiments, indications suggest that lab experiments in physics are fraught with many challenges. For example, measurement phobia, lack of interest, and irritation in the lab restrain most students' participation in laboratory practicals (Adedayo & Julius, 2015). However, observation indicates that most students feel anxious in the lab environment. This is an indication of science anxiety. The present study is aimed to examine science anxiety as a possible antecedent that could predict student participation in a physics lab experiment.

Most importantly, numerous reports indicate that affective states significantly affect students' learning and achievement (Pekrun & Linnenbrink-Garcia, 2014; Roos et al., 2020). Indeed, science anxiety is among the well-researched emotional condition inhibiting students' interest in the science discipline. The trend describes a psychological state of tension and apprehension occasioned by scientific-related events. Science anxiety denotes negative emotions about learning science (Megreya et al., 2021). The sensitivity of science anxiety is universal and spread across all cultures and ages of students (Sanstad, 2018). Generally, anxiousness contributes to attitudes toward science lessons and increases their achievement (Ucak & Say, 2019). Similarly, research has attributed students' declined interest in science and poor motivation to engage in science courses to science anxiety (Udo et al., 2004). The trend is implicated in severe psychological and psychosomatic symptoms ranging from hopelessness to complete avoidance. Accordingly, the study contends that schoolchildren with a higher level of science anxiety tend to avoid science activities and situations (Brownlow et al., 2000). More so, the unfavorable attitudes of most students relative to physics lab experiments are evident in the work of Kaya and Boyuk (2011). Importantly, considering the relevance of physics lab experiments at the secondary school level. It would seem vital to consider the factors impacting students' engagement in a lab experiment. In that sense, science anxiety is a possible antecedent that is purported in this study to affect lab participation.

Hypothesis: Science anxiety would predict a student's engagement in a physics laboratory experiment

Method

The study population includes secondary school students in the Enugu State of Nigeria. Participants comprised male and females senior secondary school students. A total of two hundred and twenty-three students who met the inclusion criteria (e.g., enrolled in science class and have visited the laboratory for an experiment) were approached with the aid of school teachers and administrators between February and April 2022. The students were prepared and informed of the study purpose before the start of the study. Out of the 223 students approached, 217 consented to partake in the research and were handed the questionnaires to fill on the spot. On observation of the retrieved questionnaires, two hundred and eleven (211) were correctly filled while four copies were wrongly filled and two were not returned. Thus the 211 correctly filled copies were subjected to statistical analysis.

Measure

Science anxiety was assessed using a revised version of the Science Anxiety Scale (Oludipe & Oludipe, 2019). The scale was modified to suit the current context. Thus, it measures the student's level of anxiety related to physics lab experiments at the senior secondary school level. The scale comprised 18 items scored in a 5-point Likert form. A higher score indicates high science anxiety. A Cronbach alpha 0.96 was obtained for the instrument following a pilot study.

Physics lab experiment participation was rated on a 10-item Linkert form scale scored in 5-point ratings ranging from 1 (not likable at all) to 5 (very likable). The scale was validated following a pilot study, and a Cronbach alpha .78 reliability coefficient was obtained. A higher score indicates high participation in practical work**.**

Result

Testing the study hypothesis

The primary assumption of the study is that science anxiety would account for the variation in students' participation in a physics lab experiment. A linear regression model was conducted to test the hypothesis. The result of the linear regression established a statistically significant effect of science anxiety on the respondent's participation in physics lab experiments at F (1,209), 24.51 P< .05 with adjusted R^2 indicating that science anxiety contributed about 11.1% of the variance in student's engagement in a physics lab experiment.

Table 1:

Table showing the regression analysis of the role of science anxiety on student's engagement in a physics lab experiment

	B	SEB	β	t	R^2	Sig	
Constant	1.85	.047		37.78	.111	.000	
Science anxiety	-.69	.062	-.69	-11.19		.000	

Discussion

The present study examined science anxiety as influencing students' engagement in physics laboratory experiments in secondary school. Two hundred and eleven senior secondary school students enrolled in the science classes participated in the study. The regression analysis revealed that science anxiety statistically significantly predicted engagement in lab experiments among the respondents F (1,209), 24.51 P< .05. The research finding suggests that the students who are anxious about science and science procedures are more likely to engage less in lab experiments than those who are science inclined. Most importantly, the result indicated that science anxiety explained about 11.1% of the differences in students'

engagement in a physics lab experiment. Thus, feeling anxious at the awareness of science-related situations might trigger a condition of withdrawal from lab engagement. The present finding entails that the students who scored high on science anxiety are most likely to avoid practical work. Therefore, militating against the development of science education. Students who have declined participation in practical learning based on the fear of science are likely to experience low performance. This assertion is reflected in the reinforced state of anxiety such that an encounter with a science subject in the future classroom could worsen the anxiety state and impair performance. Indeed, previous research has linked anxiety to poor academic achievement (Nyayieka et al., 2020; Afolayan, 2018; England et al., 2019; Sandu et al., 2021). Similarly, the result indicates that students who experience no anxiety in relation to science are keener in academic pursuit and possess a favorable attitude towards science subjects. They show more curiosity in lab experiments and probably experiment privately. Accordingly, they progress in the direction expected to achieve the goal of a scientific-driven society. However, the mechanism by which science-related anxiousness correlates with lab withdrawal remains unclear.

Limitations, strengths, and future directions

Because the study did not adopt an experimental approach, it becomes difficult to establish the cause-effect relationship of the variables. More so, the self-reported science anxiousness might trigger biases constraining the generalization of the finding. Despite the practical limitations, the present study contributes to the literature by identifying science anxiety as a determinant of engagement in a lab experiment in secondary school. Thus, the result broadens our knowledge about the negative impact of science anxiety on the development of science education. Moreover, indications suggest a scarcity of literature attempting to investigate the predictive effect of science anxiety on students' participation in a physics lab experiment in the Nigerian context. Hence, justifying the current study. Future researchers should utilize experimental methods to identify cause-effects and adopt multiple data collection approaches.

Conclusion

The linear regression analysis conducted on the study data proved the critical effect of science anxiety in predicting students' engagement in physics lab experiments at the senior secondary school level. Indeed, the research hypothesis was supported by the result of the study. Therefore, it is concluded that science anxiety is a critical determinant of students' participation in lab experiments. The finding can provide valuable data to psychologists, career counselors, and educators in achieving their various purposes relating to future directions and career choices. Also, the result offers parents and guardians the opportunity to filter the preferences of their school children. Therefore, it is recommended that school administrators and counselors invest in a robust approach that will broaden the youngsters' cognitive processes. Also, interventions to curb academic-related anxieties should be included in the curriculum.

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