Relationship between students' academic mindset, engagement and performance in Physics in Kwara State, Nigeria

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ABSTRACT
The study explored the correlation between academic mindset, engagement, and performance of students in education and physics majors. 120 students participated in the correlational survey research. SmartPLS statistical software was used for data analysis. Results indicate that academic mindset and student performance have a weak, low, and non-significant relationship, and academic mindset and student engagement positively affect academic performance in physics. It was concluded that academic mindset and student engagement are among the factors that are positively involved in the academic performance of secondary school students in the field of physics.

KEYWORDS
Academic mindset, engagement, performance in physics, mediating

RÉSUMÉ
L'étude a exploré la corrélation entre l'état d'esprit académique, l'engagement et les performances des étudiants dans les domaines de l'éducation et de la physique. 120 étudiants ont participé à la recherche par enquête corrélationnelle. Le logiciel statistique SmartPLS a été utilisé pour l'analyse des données. Les résultats indiquent que l'état d'esprit académique et la performance des étudiants ont une relation faible, faible et non significative, et que l'état d'esprit académique et l'engagement des étudiants affectent positivement les performances académiques en physique. Il a été conclu que l'état d'esprit académique et l'engagement des étudiants font partie des facteurs qui influencent positivement le rendement scolaire des élèves du secondaire dans le domaine de la physique.

MOTS-CLÉS
État d'esprit académique, engagement, performance en physique, médiation

INTRODUCTION

Physics is one of the core science subjects in the Nigerian senior secondary school curriculum. The relevance of physics is manifested in the admission policies of Nigerian tertiary institutions, which stipulate that secondary school students aspiring to study engineering courses, computer science, aeronautics, and others must have passed physics at the ordinary level and obtained a reasonable score in the Unified Tertiary Matriculation Examination (UTME).

Physics has made an invaluable contribution to national development. Its relevance cuts across various sectors, including technology, energy, infrastructure, healthcare, and defense. Physics enables mankind to understand the fundamentals of the laws governing the universe, enabling the development of advanced technologies. For instance, the invention of transistors and integrated circuits, which form the foundation of modern computing and telecommunications, is based on principles from quantum physics. These technological breakthroughs stimulate economic growth and enhance the well-being of the populace.

Physics provides insights into energy production, storage, and conversion methods. Its principles guide the development of renewable energy sources such as solar, wind, and hydroelectric power. Additionally, nuclear energy, which harnesses the power of atomic reactions, is also based on physics. Understanding the properties of materials and the behaviour of particles helps optimise energy efficiency, leading to sustainable development and reduced dependence on fossil fuels. More so, physics is found to be indispensable in other areas such as infrastructure development, healthcare, and biomedical sciences, as well as defense and security.

Despite the relevance of physics to the security, economy, and well-being of the people, unexpectedly fewer students study science at the secondary school level because of the aversion they have to physics. The few who studied physics did not perform satisfactorily in the external examinations. The statistics obtained from the West African Examinations Council pointed out this below-expected performance.

Various researchers have adduced many reasons for this unsatisfactory performance of students in science, such as how science is taught, i.e., teaching method (Akanbi et al., 2022), when science is taught, i.e., times-of-day the subject is taught in the school (Akanbi & Shehu, 2020), nature of science subjects (Umaru & Salau, 2019), who teaches, i.e., teacher' characteristics such as qualification and experience (Ademola et al., 2021), and students' characteristics such as gender and parents' education (Anaya et al., 2022; Susilawati et al., 2022). Other salient student characteristics, such as academic mindset and engagement, have been identified as likely determinants of students' performance in physics in recent studies (Jibril, 2022; Provo et al., 2022).

An academic mindset refers to a way of thinking and approaching learning that is aligned with the principles and values of academia. It involves adopting a set of attitudes, behaviours, and habits that promote intellectual growth, critical thinking, and a commitment to lifelong learning. An academic mindset is driven by curiosity and involves asking questions, seeking answers, and constantly seeking to expand one's knowledge base. Chew and Cerbin (2021) define a student's mental mindset as the attitudes and beliefs that the student has regarding the course. Mindset consists of multiple components. For instance, students have beliefs about their ability to perform well in the course, the amount and type of effort they must put forth to perform well, how crucial it is for them to perform well in the course, how much they look forward to the course, and the importance to them of the information presented in the course (Farrington, 2013).

Academic mindsets are the opinions people have about themselves concerning academic effort. According to Dweck (2006), mindset comes in two forms: a growth mindset and a fixed mindset. Students with a growth mindset, or an incremental theory of intelligence,

believe that intelligence is malleable and can be developed by learning. They adapt their learning goals and have a mastery-oriented response to setbacks. Students with a fixed mindset or an entity theory of intelligence believe that intelligence is something they possess and cannot be changed. They adopt performance goals and often have a helpless response to setbacks (Dweck & Leggett, 1988).

Just like academic mindset, engagement is another important construct that influences students' performance in science subjects. According to Krause and Coates (2008), student engagement is the amount of time spent participating in activities that provide excellent educational effects. It can be stated that students who do not actively get engaged are liable to fail. Academic achievement, retention rates, and other desired outcomes have all been linked to student engagement (Ayub et al., 2017).

Student engagement consists of behavioural, cognitive, and emotional components. A deep understanding of how these engagements relate would enable teachers to construct and facilitate more interesting learning experiences for students (Manwaring, 2017). Students' engagement has become an essential topic of study for many researchers (Estévez et al., 2021; García-Martínez et al., 2021).

However, to the best of our knowledge, there has been no research into the relationship between students' academic mindset, engagement, and performance in physics in Kwara State, Nigeria. While studies on mindset and academic achievement (Zhang et al., 2017) and growth mindset and learning engagement (Xiao et al., 2023) have been conducted and are reviewed in this study, On the other hand, previous studies have been conducted in Turkey, Egypt, and Australia.

LITERATURE REVIEW

Mindset is a theory of motivation that examines people's ideas regarding their intelligence, including whether it is a fixed and predetermined quality or something that can be developed and changed. According to Dweck and Yeager (2019), mindset refers to the ways that a person's views about the malleability of their own intelligence affect their learning and accomplishments. It covers the ideas and traits connected to various mindsets and places mindset theory in connection to incremental and entity theories of intelligence.

Many theoretical frameworks and definitions of intelligence have been expanded into vast domains of academic literature and research, making the nature of intelligence a hotly debated issue (Sternberg, 2019). Intelligence is defined as intellectual and cognitive capacity that is "typically defined in terms of a person's ability to adapt to the environment and to learn from experience". This definition is accepted by the scientific community (Sternberg & Kaufman, 2011). For the majority of theoretical conceptions of human intelligence, this environmental adaptation is essential (Sternberg, 2019). Persuasive arguments that intelligence is a learnable feature that can be developed have gradually challenged outdated conceptualizations of intelligence as a fixed trait (Sauce & Matzel, 2018).

A person's perception of intelligence as a fixed or changeable attribute can have an impact on their behaviour as a learner. This is the subject of mindset, a theory of motivation that focuses on these implicit theories of intelligence (Dweck, 2017). It was first developed as "Implicit Self-Theories" in the social psychology field and resulted from Dweck's early study on behaviours related to learner helplessness (Deiner & Dweck, 1980). This work gave rise to the socio-cognitive paradigm known as "mindset theory," which focuses on the potential effects of implicit theories of intelligence on learner motivation and outcomes (Dweck, 2000; cited by Pippa, 2021).

In the Mindset Theory model, people who believe that intelligence is a flexible, changeable attribute and hold incremental beliefs are called to have "growth" mindsets, whereas people who hold entity or "fixed" mindset beliefs believe that intelligence is fixed (Dweck, 2017). The ongoing development of implicit theories of intelligence, which now recognize that intelligence is influenced by both hereditary, predetermined elements and malleability, has an impact on Dweck's work as well. According to Sauce and Matzel (2018), these effects are not exclusive to one another, and intelligence can still be malleable even in cases where heredity plays a significant role. According to mindset theory, intelligence can be impacted by both hereditary and environmental influences.

According to Hulleman et al. (2011), mindset theory primarily focuses on how learner qualities and motivation are developed through goal setting, which is influenced by ideas about intelligence. These aspects of learner development may have an impact on educational outcomes. For many years, motivation-related educational research has concentrated on the various kinds of objectives that students establish for themselves (Urdan & Kaplan, 2020). According to Senko et al. (2011), people's objectives are usually influenced by the results they hope to achieve, such as gaining new information and abilities or being perceived as performing well on a test.

Learners who like to be perceived as performing well may choose a task that is easy and familiar in order to guarantee a high score, thus establishing a "performance goal". When presented with an identical task selection, a student seeking to expand their knowledge and abilities can select a task that is less familiar or more difficult and concentrate on the lessons they could acquire from the experience (Dickhäuser et al., 2016).

According to the body of research on implicit self-theories and mindset theory, people who primarily hold growth mindset beliefs may develop mastery approach goals (Dweck, 2017). Haimovitz et al. (2011) assert that individuals with fixed mindset beliefs may be more likely to establish performance goals as a means of proving their intelligence. These are objectives that centre on improving learning through the mastery of learning processes or on demonstrating superior performance over others and their comparative attainment.

However, engagement is a construct linked to motivation, where motivation represents intention and engagement represents action (Reeve, 2012). In the past two decades, engagement has been extensively researched as a key factor in achieving educational expectations. Studies have shown that student engagement positively predicts academic achievement, with a moderately strong and positive correlation between overall engagement and academic achievement (Lei et al., 2018; Pavlin-Bernardić et al., 2017). The authors still lack consensus on the definition and complexity of engagement. The concept of engagement is commonly seen as a multifaceted construct that shares three components across domains: emotive, cognitive, and behavioural (Amado & Roleda, 2019; Kelders et al., 2020; Mendoza & King, 2020).

Behavioural engagement is demonstrated through positive behaviour, rule-following, effort, persistence, concentration, attention, communication, and school commitment (Fredricks et al., 2004). Emotional engagement consists of positive and negative emotions experienced during learning, such as interest, anxiety, and frustration (Zhoc et al., 2020). Cognitive engagement involves how students attend to information, store it in memory, access knowledge, and apply it to problem-solving. Indicators of cognitive engagement include surface strategies (memorization and practice), deep strategies (comprehension, summarization, and connecting new and existing knowledge), and reliance on parents and teachers (Deng, 2021). In addition, this study also attempted to analyse the relationship between students' academic mindset, students' engagement, and students' academic performance.

The following hypotheses were raised in line with the objectives of the study:

H1$_A$. The entity dimension of students' academic mindset positively relates to students' academic performance;

H1B. The incremental dimension of students' academic mindset positively relates to students' academic performance;
H1C. The entity dimension of students' academic mindset positively relates to students' academic engagement;
H1D. The incremental dimension of students' academic mindset positively relates to students' academic engagement;
H2A. The entity dimension of students' academic mindset positively relates to students' academic performance when mediated with students' academic engagement;
H2B. The incremental dimension of students' academic mindset positively relates to students' academic engagement.

METHODOLOGY

Research Design

In this study, a correlational survey research design was adopted. This was used to determine if there is any relationship between academic mindset, engagement, and academic performance among students' majors in education and physics at the College of Education and University in Kwara State, Nigeria.

Population, Sample and Sampling Techniques

The population of this study consisted of all college and university students in Kwara State. The target population comprised college of education students and university undergraduate students offering physics education in Kwara State, Nigeria. A stratified sampling technique was used to categorise schools into college of education and University. 120 students (40 college of education students and 80 undergraduate university students, respectively) were conveniently selected to participate in this study.

Instrumentation

The instrument used in this study was adopted and adapted. It consists of 24 items (see Table 1). Fourteen of the items were taken from Abd-El-Fattah and Yates (2006); 7 items reflected the entity dimension of students' academic mindset, and 7 items reflected the incremental dimension of students' academic mindset. Ten items out of 23 items was adapted from Handelsman et al. (2005) instrument known as Students Academic Engagement Scale SAES. Participants in this study rated their relevant or not relevant per item on a four-point Likert type scale of "Not relevant", Relevant", Fairly relevant", and "Very relevant".

TABLE 1

*Student Academic Mindset, Students' Academic Engagement, and Students' AcademicPerformance Measure (*Source: Field work, 2023)

Construct	Source	Number of Items	Number of Items Adopted/Adapted	Reliability Coefficient (α)
Entity dimension of Students' Academic Mindset	Abd-El-Fattah and Yates (2016)	7	7	All items having factor loading > 0.44
Incremental dimension of Students' Academic Mindset	Abd-El-Fattah and Yates (2016)	7	7	All items having factor loading > 0.44
Students Academic Engagement	Handelsman et al., (2005)	23	10	
Students' Academic Performance	Researchers' self designed			

Measurement Model

The validation of the items and constructs is made easy through the measurement model of the structural equation model (see Table 2). The second part presents the measurement model analysis of the instrument(s) used in collecting data and shows its appropriateness and consistency level (Table 3).

TABLE 2

Fornell Larcker Criterion

Constructs	Entity dimension of academic mindset	Incremental dimension of academic mindset	Students' academic engagement	Students' academic mindset	Students' academic performance
Entity dimension of academic mindset	0.689				
Incremental dimension of academic mindset	0.517	0.748			
Students' academic engagement	0.661	0.681	0.628		
Students' academic mindset	0.817	0.915	0.778	0.623	
Students' academic performance	0.589	0.850	0.830	0.858	0.684

TABLE 3

Convergent Table

Construct	Cronbach Alpha (CA)	Composite Reliability (CR)	Average variance Extracted (AVE)
Entity/fixed dimension of students' academic mindset	0.811	0.857	0.474
Incremental/growth dimension of students' academic mindset	0.868	0.871	0.560
Students' academic engagement	0.825	0.841	0.394
Students' academic mindset	0.871	0.891	0.389
Students' academic performance	0.871	0.890	0.468

Procedure

The duration of data collection lasted for 2 working days. The researchers visited the schools where the study was carried out. Copies of an informed consent form were distributed to the physics education students for endorsement to indicate their willingness to participate in the study.

The researchers make it clear to the students that their participation is voluntary in the study, in conformity with standard ethical practice. If any participant, however, decides to withdraw from the research at any time, such participant may do so without any hindrances. Participants are not exposed to any risk because all the activities will take place in the school during school opening hours. All school rules were adhered to, and all necessary precautions were taken to prevent any form of hazard to the participants. The names of the sampled schools as well as those of the participating students were handled with the utmost confidentiality and

not disclosed at any point in this study. The participants were told that the questionnaire collected from them would be used for data analysis.

THE STRUCTURAL MODEL RESULT

The collected data were collated and coded using IBM SPSS version 23, and the analysis was done using SmartPLS statistical software version 4.0.9.2.

The structural model part of the structural equation model determines the constructs (predictor and outcome variables), relationship strength (low/average/large), direction (positive and negative), and significance ($p<.05$, $t>1.96$).

TABLE 4

Relationship between students' academic mindset and Students' Academic performance

Path Relationship	Path Coefficient	Coefficient Mean	R Square	Adjusted R Square	t-value	p-value	Remark
Entity/fixed dimension of students' academic mindset ->Students' Academic performance	0.042	0.055	0.841	0.840	0.862	0.389	$H1_A$ Rejected
Incremental/growth dimension of students' academic mindset ->Students' Academic performance	0.566	0.562			18.392	0.000	$H1_B$ Retained
Entity/fixed dimension of students' academic mindset ->Students' Academic engagement	0.462	0.464	0.622	0.620	9.089	0.000	$H1_C$ Retained
Incremental/growth dimension of students' academic mindset ->Students' Academic engagement	0.442	0.436			8.717	0.000	$H1_D$ Retained

The results in Table 4 revealed that the entity dimension of the student's academic mindset has a weak, low, and non-significant relationship with their academic performance in physics (0.042, $t=0.862$, $p>0.05$). The incremental dimension of the student's academic mindset has a substantial and significant relationship with their academic performance in physics. The path coefficient, t, and p-values show a positive and significant relationship existed between students' academic mindset's dimension (entity and increment) and students' academic engagement. The R square value of 0.841 indicated that students' academic mindset explained 84.1% of their academic performance, while the R square value of 0.622 indicated that students' academic mindset explained 62.2% of their academic engagement, as shown in Figure 1.

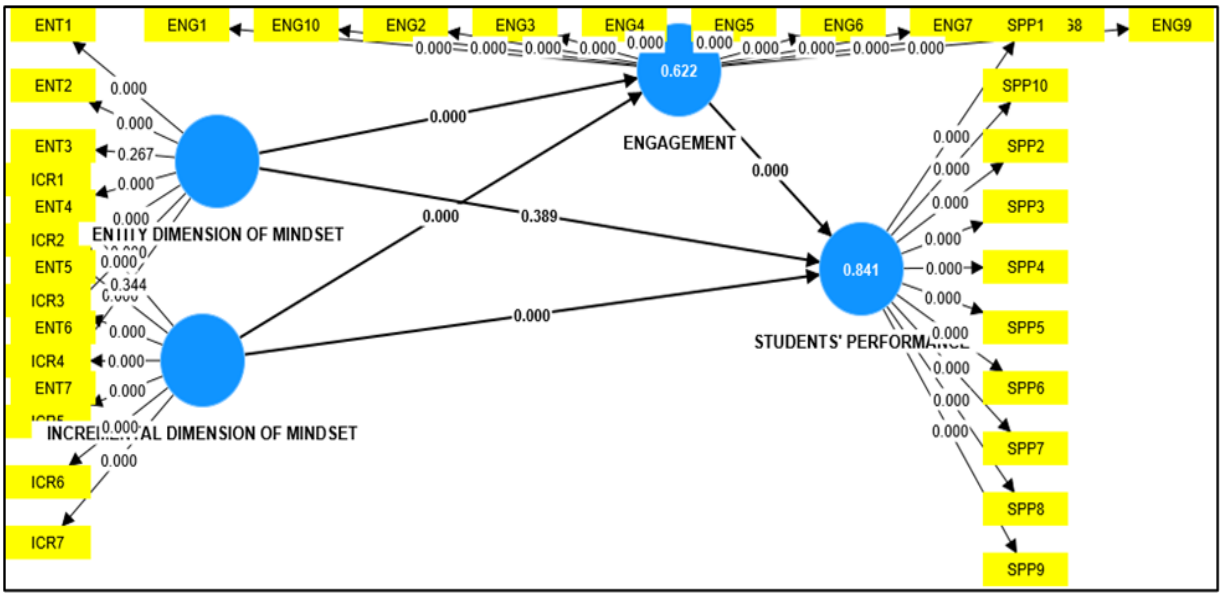
TABLE 5

Mediating role of students' academic engagement on the relationship between students'academic mindfulness and students' academic performance

Path Relationship	Path Coefficient	Coefficient Mean	t-value	p-value	Remark
Entity/fixed dimension of students' academic mindset ->Students' Academic engagement->Students' Academic performance	0.177	0.172	7.458	0.000	$H2_A$ Retained
Incremental/growth dimension of students' academic mindset ->Students' Academic engagement->Students' Academic performance	0.185	0.184	5.615	0.000	$H2_B$ Retained

The results in Table 5 revealed that the entity dimension of the students' academic mindset has a weak, low, and non-significant relationship with students' academic performance in physics when mediated by students' academic engagement. The incremental dimension of the students' academic mindset has a weak but significant relationship with their academic performance in physics when mediated by their academic engagement.

FIGURE 1



The graphical output of the relationship between students' academic mindset dimensions, students' engagement and students' performance.

DISCUSSION, CONCLUSION AND RECOMMENDATION

The study investigated the relationship between dimensions of students' academic mindset', engagement, and academic performance. The relationship between the variables was analysed

using the multivariate statistical method known as the structural equation model via SmartPLS statistical, also known as the next "generation statistic". This method is divided into measurement and structural models. The measurement model of this method determines and explains the validity and reliability indexes of the instrument(s) used in measuring the variable(s) of interest and their measures. The structural model of the method shows the relationship level and its significance among the variables. The relationships between the students' variables are direct and indirect (mediating relationships). The direct relationship result of the entity dimension of the students' academic mindset has a weak and non-significant relationship with students' academic performance, though it has a strong and significant outcome with students' academic engagement, and the indirect result of the model indicates that students' academic engagement significantly mediates the relationship between the entity dimension of the students' academic mindset and students' academic performance.

The result of the incremental dimension of the students' academic mindset has strong and significant relationships with the students' academic performance and engagement. The indirect result of the model also indicated that the mediating role of the students' academic engagement in the relationship between the incremental dimension of the students' academic mindset and performance was weak and significant. The findings revealed that academic mindset is a factor to be taken into consideration when discussing the causes of a student's academic outcome. The R square value in Table 4 implies that academic mindset plays a significant role in student academic performance and engagement. The mediating factor of students' engagement also plays a vital role in the positive determination of students' academic performance. The finding is in agreement with the study, which shows that engagement is positively related to the academic performance of students (Dimitriadou et al., 2020). Similarly, positive student emotions through engagement result in the enhancement of their performance (Carmona-Halty et al., 2021).

In conclusion, the findings of this study show that academic mindset plays a significant role in student academic performance and engagement. The combined students' engagement (behavioural, emotional, and cognitive) was positively related to performance in physics. Thus, academic mindset and student engagement are among the factors that are positively involved in the academic performance of secondary school students in physics. Our results also have practical implications for educators. Educators and policymakers should focus on promoting a growth mindset among students and encouraging students to view challenges as opportunities for growth, which may enhance both academic performance and engagement. While the study provides valuable insights, it's essential to acknowledge its limitations. The cross-sectional design limits our ability to establish causality and other unmeasured variables (e.g., socio-economic status, teaching quality), which may also influence academic outcomes. It is suggested that future research should conduct longitudinal studies, which could explore how changes in mindset over time impact academic performance.

It is recommended that researchers and practitioners conduct a longitudinal study to track students' mindset beliefs and academic performance over an extended period and design more effective mindset interventions to promote students' success in physics. It is also advisable to acquaint students with the notion that intelligence and abilities can be enhanced through dedicated effort and consistent practice. More so, it is recommended that student engagement be promoted by creating a positive learning environment for the teaching and learning process, and science should be made relevant and relatable so that students can apply what they learn in the classroom to overcome challenges in the real world.

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