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Research Article

Predictive Abilities of Curiosity, Creativity, and Motivation on Academic Performance of High School Students in Ghana

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The study looked at how learners innate possessions (motivation, curiosity, curiosity) affect their performance (science and mathematics). A total of 568 high school students were surveyed through a quantitative-correlational research design. Data for the study were gathered using an adapted curiosity measure, an adapted creativity measure, an adapted motivation measure, and an expert-developed academic performance measure. Multiple multivariate was used to test the hypothesis. The study revealed that students' motivated behaviors, curious abilities, creative potentials jointly explained 15.5% change or variance in science score and 33.1% change or variance in mathematics score. In this sense, it is evident that students' who become curious, creative, and motivated in their learning situation could improve upon their academic performance and achieve their academic goals. Therefore, school managers of high schools should call for intersubject workshops, as it is evident that science and mathematics are related. Furthermore, the Ghana Education Service should revise the way and manner in which it organizes professional development programs for practitioners in order to make them cross-curricular.

1. Introduction

Many child development experts suggest that curiosity plays an imperative role in nurturing ideal development in children [1]. Curiosity is a behavior thought to exist throughout one's lifespan, but the composition of its manifestation varies qualitatively with development. It is associated with adaptation, survival, and progress throughout the history of human beings. McGillivray et al. [2] inferred that curiosity plays a critical role in inspiring learning and unearthing knowledge by creating professionals and increasing the store of knowledge among people globally.

von Stumm et al. [3] have shown that students with an appreciable level of curiosity are more hard-working, well-organized, and have the tendency to perform better academically. As an important psychological construct for teaching and learning, curiosity is not about individual feelings but about growth and development among students [4]. According to Cankaya et al. [5], Gallagher and Lopez [6], and Kashdan et al. [7], curious students are likely to engage in unique and perplexing conditions in their daily routine and will meet and involve themselves more in prospects for progress and anticipated consequences.

Creativity is about students' ability to use imagination and critical thinking to create new and eloquent procedures of thought by taking risks, being self-reliant, and being flexible [8]. The growing interest in creativity in education is owed to the need for more serious thinkers in business, science, politics, and other subjects in order to solve multifaceted problems. Papaleontiou-Louca et al. [9], in a meta-analysis of the literature on creativity, suggested that the educational structure does not adequately encourage and accept creative thinking among students. In the educational system, creativity helps students to become innovative and aids their transfer of knowledge across similar learning situations [10]. In furtherance of the argument, Konstantinidou et al. [11] proposed the incorporation and improvement of creativity in professional training and the school system because it plays a major role in nurturing individuals purposefully for an undefined and multifaceted world of work.

Motivation is termed the "most captivating area in education" that has attracted attention and could help in higher academic performance [12]. According to Amrai et al. [13], motivation among students is internal and sparked by context, temperament, goals, and instruments. For students to realize their goals, wants, and urges optimally, a desirable motivation is required. According to Akpan and Umobong [14], motivation is a solid influence toward success, while Muola [15] indicated that motivation is an element that brings about academic success. As such, teachers and parents should encourage it in the education of students.

2. Curiosity as a Predictor of Academic Performance of Students

Prospectively, for curiosity to be present in students, they should have some form of knowledge concerning a particular area. Evidence of convenient information gaps that supplement a learner's regular curiosity, combined with clear associations to the learner's value system, will result in learner tension-to-learn [16]. According to Hong-Keung et al. [17], curiosity provokes an inner wish to learn new information, and this directly influences students' intrinsic motivation and academic performance. Curiosity is a risk factor for anxiety disorders and has adverse consequences in academia [18].

Eren [19] established a positive correlation between epistemic curiosity and student success. Epistemic curiosity also correlates with deeper learning abilities engaged by students [20] and then with degrees of engagement [21]. Evidence-based research conducted among Hong Kong higher education students by Hong-Keung et al. [17] revealed that curious students exhibited higher intrinsic motivation in obtaining knowledge in some subjects, which consequentially improved their academic performance. Similarly, a study of 308 college students in the United States found a positive relationship between openness and academic achievement, which was aided by curiosity [22]. Eren and Coskun [21] surveyed 557 high school students in Turkey and found curiosity to be a significant predictor of their academic performance. In this particular study, both interest-specific epistemic curiosity and deprivation-specific epistemic curiosity significantly and positively predicted the academic performance of students. A study conducted in Nigeria by Abakpa et al. [23] revealed a weak and negative relationship between curiosity and academic performance in students.

3. Creativity as a Predictor of Academic Performance of Students

Creative behaviors are indispensable in the lives of learners because they serve as a panacea for success. Rahmawati et al. [24] discovered in a study that students' creative abilities predicted their mathematical performance with a variance of 27.6%. Atwood and Pretz [25] stated that the association between creativity and academic achievement has been a subject of concern among educational psychologists due to conflicting research findings. Buttressing this, research findings such as those of Niaz et al. [26] and Dollinger [27] revealed that creativity was positively related to the academic performance of students. Conversely, researchers such as Blake et al. [28], Boulter [29], and Furnham et al. [30] found a significant relationship between creativity and academic achievement, but the direction was negative. Pretz and Kaufman's [31] study among undergraduate students revealed that creativity-related mildly and positively to standardized test scores.

Researchers such as Silvia and Beaty [32] and Nusbaum and Silvia [33] found effect sizes of .49 and .45 for the relationship between creativity and academic performance, respectively. These effect sizes suggest that there is a positive relationship between creativity and academic achievement among students. In their study among students in different educational stages, Karwowski et al. [34] found a positive but weak correlation between creativity and academic achievement among students, where female and male students had similar creative abilities. Conversely, the findings of Karwowski et al. [34] did not corroborate those of Olatoye et al. [35]. Olatoye et al. [35] conducted a study among students and focused on how related creativity was to their academic performance. The study revealed that there was a negative, inconsequential correlation between creativity and students' cummulative grade point accumulation scores. The researchers further indicated that low creativity could lead to low performance and as well, highly creative people might not necessarily be good achievers.

4. Motivation as a Predictor of Academic Performance of Students

Motivation as a compelling urge has contributed enormously to the academic lives of students. In a study of 581 university students in Hong Kong, Ning and Downing [36] discovered that motivation was the strongest predictor of academic performance than other factors. The finding was related to previous findings of studies such as Assor et al. [37], Dweck [38], Hagger et al. [39], Jang et al. [40], and Loima and Vibulphol [41], where motivation and academic performance were found to be related. Relatedly, relationships were established between motivational orientations and academic achievement in 324 randomly selected students in Brunei Darussalam, where the positive and significant correlations between all six motivational orientations and achievement produced positive values [42]. Buehl [43] discovered a link between achievement motivations and student performance in any learning task in a study of 482 randomly sampled undergraduate students in the United States. In Ogun State, Nigeria, Kassim et al. [44], in a study among students concerning academic motivation and academic performance, they found that academic motivation predicted the academic performance of students with an effect size of .321. In their study among Grade 12 students in Ghana, Dramanu and Mohammed [45] found a significant positive relationship between academic motivation and academic performance.

5. Theoretical Framework

5.1. Curiosity-Drive Theory (CDT) by Berlyne [46]. The curiosity-driven theory is a psychological viewpoint that believes that curiosity is an inner drive that initiates within people, similar to sleep, sex, hunger, and thirst [47]. Berlyne [46] proposed this theory with the view that organisms' information-seeking behaviors are possible through curiosity reduction. Berlyne's curiosity-drive theory (CDT) likened curiosity to quite unpleasable experiences of "ambiguity," prompted by interaction with unique, difficult, or unclear environmental events. The unpleasant nature of the situation propels people to minimize their feelings, which in turn becomes rewarding [48]. When consistency is disrupted by unclear things, CDT proposes that it is curiosity-driven that attempts to organize information and understanding of the unclear situation in order to bring about consistent thinking processes. The theory indicates that curiosity occurs based on the wish to make meaning out of unclear situations in one's environment through exploration [49]. Berlyne [46], in a series of studies, reported that the observation of new and uncommon situations causes exploratory behaviors in human beings and animals, and the moment new information is found, exploration ends, signifying that uncertainties have been resolved. Relating to the current study, curiosity in students can be sparked from within as a need, and they will try to satisfy that need. In this sense, when students feel the performance need, they will engage in curious behaviors, and eventually, their performance can be improved as they strive to satisfy the need. According to Pluck and Johnson [50], CDT can be applied in schools for the stimulation of students' innate drive toward teaching and learning. For instance, Pluck and Johnson suggested inquiry-based learning methods like problem-based learning, which seems evident in students' innate propensity toward learning and performance because solving the problem will motivate them intrinsically.

5.2. Expectancy-Value Theory of Motivation by Fishbein [51]. The expectation-value theory as proposed by Fishbein [51] has it that people's motivated behaviors are determined by the value they attach to their goals and the extent to which they expect to achieve those goals. Generally, the theory is about how people's attitudes influence their intentions, goals, and behaviors. According to the expectancy-value theory, people's behavioral decisions are influenced by their attitudes and beliefs. The theory is depicted in an equation as $B = f(E*V)$, where B is the behavior, f is the function or interaction, E is the expectation, and V is the value. The theory is suitable for many reasons because it offers explanations for motivated behaviors in terms of achievement motivation and work motivation [52].

According to Fishbein [53] and Fishbein and Ajzen [54], the expectancy aspect of the theory is about the assumption that people choose to engage in an activity even if they fail, or they will not choose to engage in the task because they feel they will fail. The value aspect, on the other hand, is concerned with the various beliefs that people hold about why they may engage in an activity. Value denotes the diverse views that students have on the motives behind their engagement in a task. The belief aspect is about an individual's conviction about something, whether personalized or attributed. Relating to the study, students' academic performance in any area is highly dependent on their beliefs, what they expect, and how they value the situation. For students who aspire to be successful, they are likely to dwell and participate in areas they perceive to be fairly difficult, while students who aspire to prevent failures are likely to dwell and participate in areas with easy success or disregard difficult academic situations. Students' decisions concerning success orientation and failure disorientation are diverse, as individual students differ in their values, expectations, and beliefs concerning academic accomplishment. As a result, it is critical for teachers and school administrators to assess the extent to which students use expectancy-value theory to maximize their involvement in teaching and learning situations. With this, the effort students put into activities simultaneously perceived to have value and expected to be successful can be established using the expectancy-value theory of motivation [55].

5.3. Honing Theory (HT) of Creativity by Gabora [56]. This creativity theory made an effort to elaborate on how culture progresses [56–59], using previous ideas as a basis to explain the association between difficulty theory and creativity [60, 61]. The honing theory (HT) of creativity views human creativity as operating on two levels. These are organismic (holistic) and psychological (mental) levels. These levels are triggered by the difficult, adaptive, and self-organizing structure [62]. According to Gabora, the psychological level makes it possible for people to identify gaps or conflicts and consider them from diverse viewpoints so that they can be consistent with their view of the world and become extra strong. The HT is seen as the transformative impact of immersion in the creative process that goes beyond the "problem domain or area" because it brings about the psychological level of difficult, adaptive structure, which varies an individual's personal concept and view of the world [62]. On the organismic level, it is a holistic growth in goal pursuits and self-determination that explains how the emotional and cognitive process of growth unfolds as an embodied "moment of movement" and analyses how this process is critically affected by changes in one's style of relating to the outside world [62].

Relating the HT to this study, it is possible that creativity among students can be developed in an environment or culture that is creative-oriented. When students find themselves in a school that has a culture of creativity, the processes and procedures can be passed on to them so that they can become creative themselves by relating their immediate problems to their earlier encounters. When procedures are successfully transferred to the students, just like cultural norms, they are likely to come up with creative products that may be used to fit the innovation and improve performance in general. It is worth noting that students who have creative ideas learn them from their immediate culture or environment based on HT, and as a result, creativity is not only caused by a need or a knowledge, but it is also transmitted from a cultural perspective, similar to a lineage.

5.4. The Ghanaian Context. Globally, contemporary educational research has it that parental educational background, family income level, parental status, school environment, teacher commitment, and cocurricular activities have an influence on students' academic performance [63], but students are likely to perform well academically without those factors because academic success goes beyond the background factors and may include curiosity, creativity, and motivation. The Ghana Education Service has shown that deficiencies in the home (e.g., socioeconomic status, parenting style) and the school (e.g., school infrastructure) impair scholastic attainments [64, 65]. Other important determinants of academic success, however, are within-student characteristics (motivation, creativity, curiosity).

In view of improving students' academic performance in Ghana, there have been intermittent educational reforms since 1987 [66], but these reforms appeared to have a subtle influence on students' curious abilities, creative potentials, and motivation in executing academic tasks. For instance, the new standard-based curriculum contains six core competence areas (critical thinking and problem-solving, creativity and innovation, communication and collaboration, cultural identity and global citizenship, personal development and leadership, as well as digital literacy) for students to achieve but only creativity was captured at the expense of curiosity and motivation [67, 68]. Teachers are often challenged logistically and by large classes when attempting to motivate their students [3, 45, 69, 70]. It is plausible to believe that motivation, creativity, and curiosity jointly contribute more to the performance of students than any other variable, but they remain unreported, unlike school history and the quality of students' socioeconomic backgrounds, hence a gap in the literature. Again, owing to different sociocultural practices, it will be insufficient to import studies conducted in other countries to explain the practices in Ghana. Therefore, this study makes it imperative to conduct research in the areas of creativity, curiosity, and motivation using students from Ghana, a developing country. Based on the purpose, the study was guided by a multifocus research hypothesis.

(H1) Students' curiosity, creativity, and motivation will predict their academic performance in science and mathematics.

6. Methods

6.1. Research Design and Participants. As a correlational study, the study surveyed 568 ($N = 32{,}233$) [71] participants from public high schools in the central part of Ghana. The selection of participants was based on multiple sampling approach, where purposive sampling procedure (one metro and situations where one senior high school existed), simple random sampling-lottery method with replacement (25 schools out of 46, 4 municipalities out of 6, and 7 districts out of 13), stratified-proportionate sampling procedure (to give room for fair representation) and systematic sampling procedure (to provide opportunity for every member to be selected). The design and the selection procedures were appropriate in this study because they provided an opportunity for relationships to be established between or among variables without determining the cause and effect of those related variables while all members in the target group were allowed fair representation [72–74]. Gender-wise, female participants dominated the sample ($n = 288$, 50.7%) and male participants ($n = 280$, 49.3%) while their overall average age was 16 years ($M_{age} = 16.80$, $SD_{age} = .98$). Thus, participants were basically within middle adolescence. The study was ethically approved by the Institutional Review Board of the University of Cape Coast with a reference number CES-ERB/UCC.EDU/V4/20-09.

6.2. Measures

6.2.1. Curiosity Scale. Students' curious abilities were assessed with an adapted version 25-items five dimensions of curiosity with a composite reliability (CR) coefficient of .71 [75]. The scale was subjected to revalidation using the confirmatory factor analysis approach (SPSS-AMOS Software Version 25.0) with another sample of 168 participants. The fit indices such as χ^2, root mean square residual (RMR), root mean square error of approximation (RMSEA), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), and comparative fit index (CFI) were considered in the validation process. With χ^2, it produced a significant value <.05, which implies "badness of fit", thus, $\chi^2(1, 265) = 454.7$; $p = .000$ for curiosity scale. The goodness of fit significant value for χ^2 was supposed to be ≥.05 [76]. However, the recorded significance in p-value could be as a result of the large sample size as the literature indicates that this particular index is sensitive to larger sample size that could lead to the rejection of the model, where in this study, a large sample size was used. Again, the significant χ^2 results might be the reason that this particular test assumes multivariate normality, as severe deviations from normality could lead to the rejection of the model even when the model is properly specified [77, 78]. Therefore, the results might not be exact based on the issues raised.

Again, the RMSEA was checked and it produced a moderate model with a p-value of .065 [76] while the GFI and AGFI produced a permissible values between .89 and .93 [76, 79, 80]. The RMR produced an appreciable value of .019 [76, 81] whereas the CFI produced a traditional value of .90 [76] and this implies that the data had good model fits for most of the indices. The factor loadings were acceptable as they fell between .414 and .777 estimates [82]. In terms of validity, the convergent validity was satisfied as the average variance extracted with a cut-off point of .40 used as the basis [83]. The discriminant validity was established by finding the square root of the average variance extracted (AVE) value. Thus, $\sqrt{.40} = .632$, which is less than CR of .842, which implies that there were no discriminant validity problems [84].

6.2.2. Creativity Scale. Students' creative abilities were assessed with an adapted 50-items of K-DOCS (Kaufman's Domains of Creativity Scale; $\alpha = .86$) [85]. Using another sample of 168 participants, the scale was subjected to a confirmatory factor analysis procedure (SPSS-AMOS Software Version 25.0) where fit indices such as χ^2, RMR, RMSEA, GFI, AGFI, and CFI were considered in testing the model fit. In this case, the χ^2 ($\chi^2(1, 265) = 219.1$; $p = .000$) produced a significant value <.05, which implies "badness of fit" for creativity scale [76]. However, the recorded significance in p-value could be as a result of the largeness of the sample size. The literature indicates that this particular index is sensitive to larger sample size that could lead to the rejection of the model, where in this study, a large sample size was used [77, 78]. Therefore, the results might not be exact based on the issues raised. The RMSEA produced a moderate model with a p-value of .072 [76]. The GFI and AGFI produced permissible values of .90 and .87, respectively [76, 80]. The RMR produced a value of .064 [76, 81]. The CFI produced a value of .89 [76]. Deducing from the results, it can be said that the fit indices met the criterion estimates and the model was acceptable.

The factor loadings were between .233 and .723 estimates and only a factor labeled CRTDE8 under artistic creativity was deleted as it loaded below .250 [82]. Regarding validity, convergent was established using average variance extracted (AVE) of .28 with a cut-off point of between .25 and .50 and CR of .6 and above was used as basis [83]. According to Fornell and Larcker [83], situations where AVE is <0.5, while CR is higher than 0.6, the convergent validity of the construct is satisfied. The discriminant validity was established by finding the square root of the AVE value. Thus, $\sqrt{.28} = .529$, which is less than CR of .817, implied that there are no problems of discriminant validity in the study [84]. Based on convergent and discriminant outputs, it is evident that construct validity was satisfied.

6.2.3. Motivation Scale. Students' motivational orientations were established with an adapted 28-items seven dimensions academic motivation scale (AMS-28) with a CR coefficient of .79 [86]. Using another sample of 168 participants, the scale was subjected to confirmatory factor analysis (SPSS-AMOS Software Version 25.0) and fit indices such as χ^2, RMR, RMSEA, GFI, AGFI, and CFI were considered in testing the model fit. With χ^2 ($\chi^2(1, 265) = 604.8; p = .000$), it produced a significant value <.05, which implies "badness of fit" [76]. The RMSEA was checked, where it revealed that the model was moderate with a p-value of .051, which fell between p-values of .05 and .10 for continuous data. This indicated an appropriate model fit [76]. The GFI and AGFI produced permissible values of .91 and .86, respectively [76, 80]. The RMR was checked, where it produced a value of .041, less than the cut-off point of .09 which imply a good model fit [76, 81]. With the CFI, it produced a value of .98, which implied a good model fit [76].

The factor loadings were between .609 and .910 estimates and these imply that the factors loaded well [82]. In terms of validity, convergent was established using an AVE of .56 with a cut-off point of between .4 and .5 with CR of .6 and above was used as basis [83]. According to Fornell and Larcker [83], situations where AVE is <0.5, while CR is higher than 0.6, the convergent validity of the construct is satisfied. The discriminant validity was established by finding the square root of the AVE value. Thus, $\sqrt{.56} = .748$, which is less than CR of .828, implied that there are no problems of discriminant validity in the study [84]. Based on convergent and discriminant outputs, it is evident that construct validity was satisfied.

6.2.4. Academic Performance. Core mathematics (KR-21 = .793) and integrated science (KR-21 = .768) scores were used as proxies for academic performance. Using these subjects as reference point is supported by the literature. For instance, most often in schools, students' affective reactions and inspirations toward mathematics and science are negative, hence curiosity, creativity, and motivation could help leverage such experiences [87, 88]. More importantly in Ghana, students' progression from high school to tertiary is dependent on mathematics and integrated science. The lowest score within the distribution of scores was 11 for core mathematics and the highest score out of a total possible score of 50 was 48 while for integrated science, the lowest was 10 and the highest score out of a total possible score of 50 was 47. The mean score for the entire distribution for core mathematics was 31.08 with a standard deviation score of 7.26 while the mean score for the entire distribution for integrated science was 29.94 with a standard deviation score of 5.77. The scores showed that means were above the average means observed in both core mathematics and integrated science. Item difficulty was established by $P = R/T$, where R is the number of students who respond correctly to the item and T is the total number of examinees. The p-index ranges from 0 when no student correctly answered the item to 1 when all students answer the item correctly. This indicates that the smaller the p index, the more difficult the item, and the greater the p index, the less difficult the item. It should be noted that item difficulty is calculated for each item and not the entire test.

Ramsay and Reynolds [89] suggested that an effective or ideal or a good item should have a p-index ranging from 0.30 to 0.70, a more difficult item should have a p-index below 0.30, and an item with a p-index above 0.70 is considered to be too easy. Based on this suggestion, item difficulty analysis was provided to help indicate effective items, more difficult items, and easy items. From the analysis, 50 items for core mathematics had a p-index between .33 and .67 while 50-items for integrated science had a p-index between .36 and .69. Based on Ramsay and Reynolds [89] recommendation, it can be said that these items were not too difficult and not too easy for the respondents.

6.3. Data Collection Procedures. The researchers and their assistants made formal visits to the selected schools to explain the purpose of the study to the management. Ethical issues pertaining to research were discussed with the respondents. By doing this, the purpose of the study and issues of confidentiality and anonymity were made clear to the respondents. Upon gaining access to the respondents, the questionnaires were given out. The purpose of the questionnaire and how it should be answered were made known to the selected respondents. In addition, further clarification was given on items that seemed unclear to the respondents. Due to the nature of the study, sampled respondents were given pseudo-identifiers for easy tracking and to ensure anonymity, as the process of data collection was in phases, from the measure of curiosity to the measure of performance. The data were collected over a span of 3 months, where 3 days were spent in each sampled school. The first day in each school was for administering the survey tools; the second day in each school was for answering the core mathematics test; and the third day in each school was for answering the integrated science test. The administration of the questionnaires started with a curiosity measure with an activity period of 15 min. Then after, the creativity measure was administered with an activity period of 30 min, and the

Table 1: Individualized multiple multivariate regression (MMR) results (motivation, creativity, curiosity, science, mathematics).

Dependent variable	Parameter	β	SE	t	Sig.	Partial Eta square	F	p
Core mathematics	Intercept	3.388	.827	4.097	.000	.029	93.134	.000
	Curiosity	.320	.035	9.256	.000	.132	34.371	.000
	Creativity	.531	.059	8.931	.000	.124	93.134	.000
	Motivation	.169	.061	2.757	.006	.013	34.371	.006
Integrated science	Intercept	6.406	.971	6.599	.000	.072	93.134	.000
	Curiosity	.150	.041	3.682	.000	.023	34.371	.000
	Creativity	.372	.070	5.335	.000	.048	93.134	.000
	Motivation	.343	.072	4.770	.000	.039	34.371	.000

p-values are significantly significant as .025. (a) $R^2 = .331$ (adjusted $R^2 = .328$). (b) $R^2 = .155$ (adjusted $R^2 = .150$).

motivation measure was the last with an activity period of 20 min. The activity time for each performance measure was 50 min, making it 100 min for the performance measures while an overall engagement period for the process was 165 min (2 hr 45 min).

6.4. Analysis Procedures. Data for the research hypothesis were analyzed quantitatively with inferential statistics using multiple multivariate regression because the predictors (motivation, creativity, curiosity) were three against two criteria (science and mathematics performance). The analyses were made possible through the use of SPSS version 26.

7. Results

7.1. Research Hypothesis One: Students' Curiosity, Creativity, and Motivation Will Predict Their Academic Performance in Science and Mathematics. We tested the hypothesis to establish multiple statistical relationships among motivation, creativity, curiosity, and performance in mathematics and science using the multiple multivariate regression at Bonferroni adjustment α level of .025 (.05/2 = 0.025) [90]. Table 1 presents the results.

Table 1 shows results on the test conducted, where motivation, creativity, and curiosity were used as predictors of performance in science and mathematics scores. In this test, the Wilk's λ tested the omnibus hypothesis and β values across the criteria equaled zero, thus, $F(2, 563) = 25.176$, $W = .918$, $p < .025$. When mathematics score was used as the criterion ($R^2 = .331$, $F = 93.134$, $p < .025$), we found that the 33.1% change in mathematics score was caused by motivation, creativity, and curiosity. When science was used as the criterion ($R^2 = .155$, $F = 34.371$, $p < .025$.), we discovered that the 15.5% change in science score was caused by motivation, creativity, and curiosity. With individual predictions, creativity ($\beta = .531$) predicted the highest, followed by curiosity ($\beta = .320$) and motivation ($\beta = .169$) in terms of core mathematics performance, while creativity ($\beta = .372$) predicted the highest, followed by motivation ($\beta = .343$) and curiosity ($\beta = .150$) in terms of integrated science performance. In terms of effect sizes, science score recorded a weak effect size of 0.18 while mathematics score recorded a large effect size of 0.49. In this regard, it can be said that the influence of motivation, creativity, and curiosity was high in mathematics score than in science score of the participants. On this note, the hypothesis that students' curiosity, creativity, and motivation will predict their academic performance in science and mathematics was not rejected. The findings are presented with a conceptual model in Figure 1.

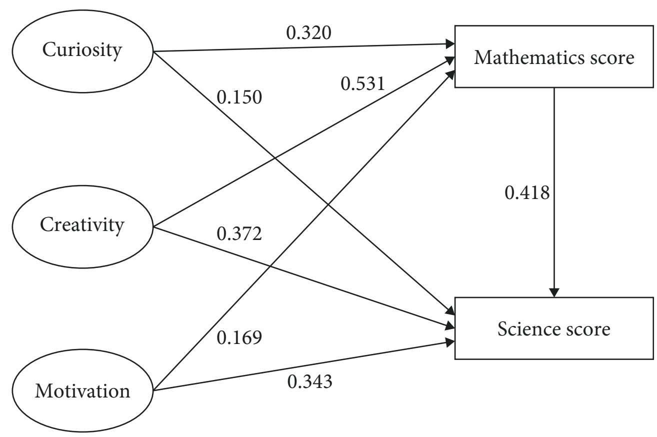

Figure 1: Parsimonious model of the predictions (motivation, creativity, curiosity, science score, and mathematics score).

Figure 1 indicates the explanatory roles of motivation, creativity, and curiosity, creativity science score and mathematics score of the participants. Among the predictors, creativity better explained science and mathematics scores than motivation and curiosity. It means that students' creative ability contributed much in mathematics and science performances than motivation and curiosity. The results imply that curiosity, creativity, and motivation can take on different roles in diverse fields and not just like going one side. Simply put, there are academic situations whereby curiosity or creativity or motivation could be used variedly.

8. Discussion

The hypothesis concerned the predictive abilities of motivation, creativity, and curiosity, in students' science and mathematics scores. The study revealed that motivation, creativity, and curiosity significantly explained students' scores in science and mathematics, where creativity explained the scores in science and mathematics better than motivation and curiosity. With creative ideas made to be exhibited by students, it will improve their performance in specific subjects such as mathematics, science, and any other subject area in school. The revelation presupposes that schools that make an effort to nurture creativity among students stand the chance to record improved academic performance because the students will have the inner urge to come up with innovative ideas to solve academic and school problems. Furthermore, schools that give room for curious activities will propel students to engage in explorative behaviors in terms of academic pursuits, which will in turn help to improve their performance. Schools that make an effort to inspire and motivate students are more likely to have students who are eager to engage in academic tasks because they enjoy doing them or because they stand to gain something if they complete them successfully. It is, therefore, important that teachers give students the opportunity to explore their learning areas, give them tasks that will hone their creative thinking, and motivate them in the process through accomplishment or tangible rewards.

The findings of the current study support the findings of many previous studies. For instance, Grossnickle [91] investigated curiosity and students' performance. The study revealed that curiosity improves students' and, as well, predicts higher academic performance. The current study's findings, on the other hand, contradicted those of Abakpa et al. [23]. They found a weak negative relationship between curiosity and academic performance among students, indicating that curiosity did not predict students' academic performance. Furthermore, the findings of the current study confirm the findings of a study conducted by Ning and Downing [36]. Motivation was found to be strongly related to and predict academic performance of students in their study. More so, the findings of the current study corroborate the findings of a study conducted by Rahmawati et al. [24]. They found that students' creative abilities predicted their performance in mathematics, with a 27.6% contribution. Conversely, the findings of the current study debunk those of Blake et al. [28], Boulter [29], and Furnham et al. [30], which found a negative relationship and predicted low academic achievement among students. However, the current study's findings were consistent with those of Silvia and Beaty [32] and Nusbaum and Silvia [33], who found effect sizes of 0.49 and 0.45 as creativity predicted academic performance, implying a moderate relationship between creativity and student academic performance.

Likewise, the findings of this study confirm a similar one conducted in Turkey by Eren and Coskun [21]. Eren and Coskun [21] found that curiosity significantly and positively predicted the academic performance of students, where both interest-type epistemic curiosity and deprivation-type epistemic curiosity significantly predicted students' academic performance. In addition, the findings of this study support those of Assor et al. [92], Assor et al. [37], De Witte and Rogge [93], Dweck [38], Hagger et al. [39], Jang et al. [40], Loima and Vibulphol [94], and Suraya et al. [95], who found that motivation and academic performance were related, where motivation significantly predicted academic performance as students became autonomous and engaged in their academic pursuits; as well, the findings of this study confirm the results of a similar study by Dramanu and Mohammed [45]. In their study, they found a significant positive relationship between academic motivation and academic performance, indicating that motivation was a significant predictor of students' academic performance.

9. Conclusion

Based on the findings, the following conclusions were made: students scientific abilities could be helped by their mathematical thoughts or other science-related courses or subjects because they are correlated positively. Under this circumstance, those who are mathematically good could become scientifically better. As a substrate of learners' mental energy, creativity was a better predictor of science and mathematics scores in its joint relationship with motivation and curiosity. The revelation could be a result of teachers' concentrating on the independent academic engagement of students (assignments, class exercises, presentations) while less emphasis is placed on students' exploration (dependent or independent) and less reward (internal or external) for their efforts. In this regard, teachers must encourage students to explore their learning areas more frequently, assign them creative tasks, and motivate them with praise or rewards as they complete those tasks.

10. Recommendations for Policy and Practice

Managers of high schools should call for cross-subject area professional development programs, as it is evident that scientific thoughts of students could be evoked by their abilities in mathematics-related subjects. Tailoring such programs to suit this suggestion will help bring about diverse teacher approaches for a collaborated effort in finding a consensual approach for teaching science and mathematics as related and complimentary subjects. Again, there is the need for revision of how professional development programs are organized for teachers by the Ghana Education Service to consider related subjects as complementary toward improved students' success.

It is recommended that school managers make efforts to develop holistic students who are more motivated, creative, and curious in pursuit of their learning goals. As psychologically oriented abilities, students need to be taught by their teachers how to improve their concentration: they should be allowed enough sleep, taught how to be self-disciplined, encouraged to exercise, engage in active learning, and taught meditation so that their general mental system can be enhanced. Schools, on their part, can help develop students' curiosity, creativity, and motivation by giving them fewer nonacademic activities after school so that their minds can be engaged. On their part, students can be asked to engage in mental and physical exercises, as these can help to make every part of their brains active. These exercises allow the free flow of oxygen to vital parts of the brain that are responsible for curiosity, creativity, and motivation, which will in turn contribute to the improvement of cognitive skills.

It is recommended that stakeholders in education have a revised focus on training students toward how to transfer the knowledge acquired in the classroom on practical-oriented life skills than pass examinations. This can be done when the management of schools facilitate the process of independence in the academic journey of students so that they can personalize and own their learning expeditions. It is about time that educational psychologists preached to teachers about the inner abilities of students and how they are exhibited. This will help teachers who may not understand some behaviors of students to be abreast of them and help them use such behaviors productively. This can be done through media advocacy, school visits, and public forums and stakeholder engagements. It is possible that teachers may not have the requisite knowledge for nurturing curiosity, creativity, and motivation among students. As a result, educational psychologists must organize workshops for teachers in order for their own dispositions to be honed and transferred into the classroom in teaching and learning situations.

Data Availability

The data for this study are available and can be given out upon written request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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