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Teachers' creativity-fostering behaviours and emotional intelligence as predictors of students' performance in circle geometry

Las conductas de fomento de la creatividad y la inteligencia emocional del profesorado como predictores del rendimiento del alumnado en geometría circular

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Abstract

This research examines how teachers‘ creativity-fostering behaviours and emotional intelligence can predict their students’ performance in circular geometry. The study was guided by two research questions and two hypotheses, and the research methodology employed was that of a survey. The starting population consisted of a total of 2056 people, and a multi-stage sampling procedure was used to draw a sample of 384 respondents, female and male: 336 students aged 15-19 and 48 teachers aged 35-58. The Teacher Creativity Fostering Scale (TCFBS), the Teacher Emotional Intelligence Scale (TEIS) and the Circular Geometry Performance Test (CGPT) were used to obtain the research data. For the statistical analysis of the data, correlations and analysis of variance were carried out. Teacher creativity-enhancing behaviours were found to predict 58% of student performance in circular geometry, while teachers' emotional intelligence explained 41%. These findings highlight the importance of fostering creative problem-solving strategies and designing tasks tailored to students' individual strengths.

Keywords: creativity; emotional intelligence; mathematics performance; adolescent students; survey methodology.

Resumen

La presente investigación examina cómo los comportamientos de fomento de la creatividad y la inteligencia emocional del profesorado puede predecir el rendimiento en geometría circular de su alumnado. El estudio estuvo guiado por dos preguntas de investigación y dos hipótesis, y la metodología de investigación empleada fue la de encuesta. La población de la que se partía estaba formada por un total de 2056 personas, y se utilizó un procedimiento de muestreo multi-etápico para extraer una muestra de 384 encuestados/as, mujeres y varones: 336 estudiantes de 15 a 19 años and 48 docentes de 35 a 58 años. Para obtener los datos de la investigación se utilizaron: la Escala de Fomento de la Creatividad del Profesorado (TCFBS), la Escala de Inteligencia Emocional del Profesorado (TEIS) y la Prueba de Rendimiento en Geometría Circular (CGPT). Para el análisis estadístico de los datos se llevaron a cabo correlaciones y análisis de varianza. Se observó que las conductas de fomento de la creatividad del profesorado explicaban el 58% de la varianza en el rendimiento en geometría circular del alumnado, mientras que la inteligencia emocional de los/as docentes explicaba el 41 %. Estos resultados ponen de relieve la importancia de fomentar estrategias creativas de resolución de problemas y de diseñar tareas adaptadas a los puntos fuertes de cada estudiante.

Palabras clave: creatividad; inteligencia emocional; rendimiento en matemáticas; estudiantes adolescentes; metodología de encuesta.

Today, mathematics is not only a crucial field of study and research in its own right; it is also essential to various intellectual pursuits. A nation's economic wealth and technological advancement rely on scientific success (Allik et al., 2020). This underscores the importance of a solid foundation in mathematics and its role in improving students' inductive and deductive reasoning (Pasnak et al., 2016; Ugwuanyi et al., 2023). Additionally, to gain admission into tertiary institutions for science or related courses in Nigeria, candidates must achieve a credit pass in the Senior Secondary Certificate Examination (Federal Republic of Nigeria, 2013). The high number of students failing the mathematics portion of the Senior Secondary Certificate Examination demonstrates that, despite the subject's importance, the desired progress remains inconsistent and minimal. The West African Examination Council's (WAEC) Chief Examiner's Reports, from 2020-2023, identified some mathematics topics as areas of weakness among the students. These topics include bearing and distances, logarithms, vectors, circle geometry, measurement, set theory, inequalities, statistics, and graphically solving quadratic equations. Perhaps these weaknesses have resulted in the poor performance of students in circle geometry over the years. Among the topics listed, circle geometry was a consistent area of weakness among the students.

Circle geometry, as a branch of mathematics, studies the properties of a circle (Wongkia, 2018). Most secondary school students have difficulty constructing, visualising, and testing geometric concepts (Massarwe, 2023). Despite circle geometry being a cornerstone of geometry, linking several significant and vital Euclidean geometry principles, students have found it challenging to understand the numerous required theorems. (Dongwi, 2014; Bosson-Amedenu, 2017; Hissan and Ntow, 2021). When students have other options in Senior School Certificate Examinations (SSCE), they avoid questions about the circle theorem. In rare cases, a handful of students who attempt questions on circle geometry demonstrate nothing but inadequate knowledge of the subject (Boyd and Ash, 2018).

Perhaps the reason for the poor performance of students in circle geometry may be that they lack the requisite ability and creativity in this subject, which ultimately leads to their poor performance in circle geometry. We can attribute the students' lack of creative thinking to the teacher's lack of innovative power and ability in teaching circle geometry, as no education system can surpass the expectations of its teachers, and nations cannot progress beyond the capabilities of their qualified educators (Okoli, 2011). Mathematics teachers are to help students build attitudes, patterns of investigation, and problem-solving skills, thereby ensuring that students grasp the right information and abilities to become more productive (Agah, 2020). To this end, mathematics teachers ought to have the ability to foster creativity among the students and control emotions in the classroom to ensure better learning outcomes for them. The capacity of the teacher to encourage creativity among

students may depend on their level of emotional intelligence (Carmeli et al., 2014; Su et al., 2022).

Ahmadi and Besançon (2017) defined the creativity-fostering behaviour of a teacher as the mental, intellectual, or imaginative ability to create and invest. The teacher can keep an open mindset towards novel concepts, exhibit humanistic control over the students, and value their independent thinking (Ozdemir and Dikici, 2017; Metu et al., 2023). According to Soh (2017), teachers' creativity-fostering behaviours include social modelling, reinforcers, alternate options, and opportunities for students to express their creativity. Teachers should know the range of behaviour that is right and acceptable for their position when they interact with students, and they should be cautious before making any decisions. These behaviours may help students become more open to learning by modelling a creative attitude, coming up with innovative solutions to challenges, and sharing ideas that encourage a creative mindset (Maazouzi, 2019; Okoro and Nwagbo, 2021). Emotional intelligence, on the other hand, is the capacity of a teacher to be self-aware of their own emotions, effectively manage and express those emotions, and navigate interpersonal relationships with students (Babajide and Amosu, 2019). This means that in an educational setting, effective teacher-student relationships translate to improved rapport, understanding, and effective problem-solving.

Previous studies seem to support the importance of creativity-fostering behaviours and emotional intelligence in students' performance. A study by Ozkal (2014) determined the effectiveness of creativity-fostering behaviours, and the findings revealed that any classroom that encourages creativity provides students with alternatives, embraces different views, and boosts the students' self-confidence. This is in line with Darling-Hammond et al. (2020), who reported that factors such as encouraging students' unusual ideas and responses, encouraging different learning activities, and creating an environment that promotes freedom of thought could enhance creative thinking in the classroom. Teachers who give students freedom and inspire originality in their students' work are crucial to their success in scientific classes (Du et al., 2019). On the contrary, when teachers criticise the inconsistent behaviour of students, they limit their creativity (Dikici and Soh, 2015). The findings of Kotsou et al. (2019) and Halimi et al. (2020) revealed that emotional intelligence plays a vital role in students' performance, with higher emotional intelligence leading to greater performance. A strong positive association was found between teachers' emotional abilities and students' performance, which accounted for a substantial 61% of the variance in academic performance (Singh & Ryhal, 2021; Akaneme & Metu, 2024). In essence, any stress affecting a teacher's emotional well-being can influence their ability to handle their students' emotions.

Based on the preceding information, creativity-fostering behaviours and emotional intelligence seem to be potential indicators of students' academic performances in mathematics. However, it's crucial to acknowledge that we cannot universally apply the assertion that teachers' behaviour and emotional intelligence have a positive influence on performance, as different subject areas and topics may have varying effects. With circle geometry being a consistent area of weakness among the students, it could be a major contributing factor to poor academic performance in mathematics. Additionally, the lack of empirical literature examining the predictive power of teachers' creativity-fostering behaviours and the emotional intelligence of students' performances in circle geometry necessitated the current study. Therefore, this study investigated a) the predictive power of the creativity-fostering behaviour of the teacher on students' performance in circle geometry and b) the predictive power of the emotional intelligence of the teacher on students' performance in circle geometry.

Following these objectives, the study tested the following hypothesis: a) the predictive power of the creativity-fostering behaviour of the teacher on students' performance in circle geometry is not significant. b) the predictive power of the emotional intelligence of the teacher on students' performance in circle geometry is not significant.

Method

The study was conducted using a correlational survey research approach. Correlation research, according to Nworgu (2015), attempts to establish the relationships that exist between multiple variables. In a similar study by Akaname and Metu (2024), Pregoner and Baguio (2024), Barr (2024) and Borgohain et al. (2024), a similar design was adopted.

Participants

The study had a population of 2056 respondents, comprising 2001 Secondary School II students and 55 mathematics teachers from Aguata Education Zone, Anambra State. The study's sample consisted of 384 respondents with an age range of 15-19 years for the students and 35-58 years for the teachers. This comprises 336 students (189 females and 147 males) and 48 teachers (37 females and 60 males). The mean age and standard deviation for the students are 16.97 and 1.21, respectively, while those of the teachers are 47.23 and 6.56.

The recommendation by Cohen et al. (2018) for determining the sample size of a finite population was used. A multi-stage sampling was used to determine the respondent's sample size. There was no sampling at the first stage. The study utilised all the schools in the education zone. At the second stage, one SSII mathematics teacher was selected from each school in the education zone. If more than one mathematics teacher was teaching SSII students, we used a simple random sampling technique to select only one teacher from each

school. This gave a total of 48 teachers used for the study. At the third stage, a stratified random sampling technique was used to select 7 students from each of the 48 schools in the education zone. This gave a total of 336 SSII students.

Instruments

This study employed the *Teachers' Creativity Fostering Behaviour Scale* (TCFBS), the *Teachers' Emotional Intelligence Scale* (TEIS), and the *Circle Geometry Performance Test* (CGPT) for data collection. TCFBS and TEIS comprise 17 items each, evaluated on a 4-point Likert scale. The items were assessed on a scale from 1 to 4, representing Strongly Disagree, Disagree, Agree, and Strongly Agree, respectively.

Teachers' Creativity Fostering Behaviour Scale

Derived from the works of Soh (2015) and Soh (2017), encompassing two dimensions: integration and motivation, used to collect information on the teacher`s creativity-fostering behaviours. Some of the items of this instrument include: I use different activities in class to maintain students' interest; my superiors do not try to block my advancement; my salary is enough for my needs; among others.

Teachers' Emotional Intelligence Assessment Scale

Was adapted from Goleman's (1996) model of emotional intelligence with dimensions of self-regulation and sociability, and used to collect data on the teachers´ emotional intelligence. The instrument includes items such as I find it difficult to control the students' emotions; I do not allow the students' moods to control me; I find it easy to adapt in a social environment, among others.

Circle Geometry Performance Test

Consisted of 20 questions with multiple choices, with each item having 4 response alternatives, which was used to gather information on the student's performance in circle geometry. The CGPT was developed using the test blueprint as a guide.

Three experts from the Education Faculty, University of Nigeria, validated the instruments. One was in the mathematics education unit, one in the evaluation unit, and one in the educational psychology unit. The TCFBS and TEIS underwent additional construct validation while the CGPT was further subjected to content validation. The Cronbach Alpha approach and the KR-20 method were used to establish reliability (internal consistency. This resulted in α coefficients of .78 for TCFBS, .85 for TEIS, and .82 for CGPT.

Procedure

The TCFBS and TEIS were administered directly to the teachers. In addition, students were given the CGPT to obtain information about their mathematical knowledge. The three instruments were distributed and collected at the moment.

The collected data was analysed using regression analysis. All the research questions were answered using the obtained *r* value. The hypotheses were tested using the obtained ANOVA at a significance level of $p \leq .05$.

Results

The study's findings demonstrate the prediction of teacher creativity-fostering practices on students' performance in circle geometry. The results suggest that the correlation coefficient (r) between teachers' creativity-fostering behaviour and students' performance in circle geometry is .76. This indicates a strong connection between teachers' innovation in nurturing behaviour and students' performance in circle geometry. The coefficient of determination (r^2) for the .76 correlation coefficient is .58. This demonstrates that teachers' creativity-fostering behaviours can predict a 58% change in students' performance in circle geometry. Therefore, 42% of the change in the students' performance in circle geometry is attributable to other variables not mentioned in this study.

The prediction of teachers' creative-fostering behaviours on students' performance in circle geometry was ascertained using analysis of variance. The result showed that $F(2, 45) = 31.48$, $p < .001$ with a mean value of 9.62 ($SD = 1.52$). The exact probability value of .001 is less than the significant level of .05 established as the threshold for testing the hypothesis, and the result was determined to be significant. As a result, the null hypothesis that teachers' creativity-fostering practices have no prediction of students' performance in circle geometry is rejected. The inference drawn is that teachers who foster creativity have a significant ($p<.05$) impact on students' performance.

The study's findings demonstrate the prediction of teachers' emotional intelligence on students' performance in circle geometry. The results revealed that the correlation coefficient (*r*) between teachers' emotional intelligence and students' circle geometry performance is .64. This suggests there was a strong positive association between teachers' emotional intelligence and the performance of the students in circle geometry. The coefficient of determination (r^2), also known as the predictive value, for the correlation coefficient of .64, is .41, accounting for 41% of changes in students' performance in circle geometry. This means that other variables account for 59% of the variation in students' performance in circle geometry.

Finally, the analysis of variance on the significance of teachers' emotional intelligence as a predictor of students' performance detected ($F(2, 45) = 15.76$, $p < .001$), with a mean value of 10.58 ($SD = 3.40$). The exact probability value of .001 is less than the significant level of .05 used to test the hypothesis, and the result was significant. As a result, the null hypothesis that teachers' emotional intelligence has no predictive ability over students' performance in circle geometry is rejected. Hence, teachers' emotional intelligence has a significant ($p<.05$) prediction on students' performance in circle geometry.

Discussion

The study's result revealed that teachers' creativity-fostering behaviour predicts 58% of students' performance in circle geometry. The results of the first hypothesis test revealed that teachers' creativity-fostering behaviours significantly predict students' performances in circle geometry. This suggests that teachers' creativity-fostering behaviours are a significant predictor of students' performances in circle geometry. Therefore, we should make classrooms as conducive as possible to maximise students' potential. Creative teachers can make the most of their experiences and resources. It is the driving force behind the growth, development, and expansion of students, organisations, and society as a whole. The study's findings are consistent with those of Du et al. (2019), who observed that creativity-fostering teacher conduct is a strong predictor of students' academic progress in science activities. The results of this study are also in line with those of Okoro and Nwagbo (2021), who discovered that students who had teachers who emphasised creativity outperformed those who had teachers who emphasised moderate creativity in biology. These findings further highlight the importance of teachers' creativity-fostering behaviours as a significant predictor of students' performances in circle geometry.

The study's findings revealed that teachers' emotional intelligence predicts 41% of a change in students' performance in circle geometry. The results of the second hypothesis test revealed a significant correlation between teachers' emotional intelligence and students' performance in circle geometry. Therefore, emotional intelligence will help to build a positive relationship between the teacher and the students, which in turn will promote positive rapport, good understanding, and ways of solving mathematical problems. Babajide and Amosu (2019) reported a strong influence of students' emotional intelligence on their physics performance, which aligns well with these findings. The results of this study align with the findings of Halimi et al. (2020), who found that emotional intelligence abilities are crucial indicators of academic success, significantly impacting students' performance, and the higher the emotional intelligence, the higher the students' performance. These findings

highlight the importance of teachers' interpersonal abilities as predictors of students' performance in circle geometry.

Conclusion

The research findings showed that teachers' creativity-fostering behaviours significantly predicted (58%) students' performance in circle geometry. This underscores the crucial impact of the teacher's actions on students' performance. Similarly, the study revealed that the emotional intelligence of the teacher is an important predictor (41%) of the performance of the students in circle geometry. A classroom environment that promotes creativity gives students options, encourages diverse ideas, enhances self-confidence, motivates them to study, and incorporates creative learning methods. Teachers with emotional intelligence may engage their students more effectively, understand their feelings and well-being, handle disruptive behaviour and academic accomplishments, and develop relationships with sensitivity. The findings and information on motivation will stimulate the desire of the mathematics teachers to constantly come for classes and effectively discharge their duties. It is concluded that students can use their creative abilities when exposed to a positive learning environment. Teachers will learn that students display varying emotions, which means they cannot behave uniformly. The teachers need to assess how students think, evaluate, or perceive themselves for better achievement in both internal and external examinations.

This study has some limitations. First, only teachers and students in Aguata Education Zone, Anambra State, were used for this study. Future researchers should replicate this study with a wider geographic scope to ensure generalisability. It is possible that some respondents misrepresented their responses, which might have somewhat impacted the study's findings; therefore, other instruments may be used by future researchers to replicate this study over an extended period to check the consistency of the results. It was therefore recommended that teachers create multiple ways to solve mathematical problems and tasks that play to the unique strengths of each student. Mathematics teachers should participate in constant in-service training to better prepare them with cutting-edge teaching techniques to meet the individual needs of the students.

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