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**ROLE OF CREATIVITY AND INNOVATION IN MATHEMATICS LEARNING: A CASE OF SPECIAL EDUCATION****Sharon Mnena Abaver***Department of Mathematics Education, University of South Africa, Pretoria, South Africa**E-mail: [sharonjude85@gmail.com](mailto:sharonjude85@gmail.com)**Received 25 March 2026; accepted 15 June 2026; published 30 June 2026*

**Abstract.** Education is seen as central in fostering creative and innovative skills. Creativity and innovation are very important aspects of learning mathematics in education. This study explores the impact of creativity and innovation on mathematics learning in special education. Despite challenges in mathematics education, integrating creativity and innovation can enhance students with special needs' problem-solving skills. Creativity and innovation can be applied in special education through student motivation approaches, such as creativity-integrated mathematics instruction. The study used a mixed-method research design to investigate the effects of creativity and innovation on mathematics problem-solving skills and teachers' perceptions. Data were collected from 92 grade 8 special needs students and 10 grade 8 mathematics teachers in special schools in Gauteng, South Africa, to determine the impact of creativity-integrated mathematics instruction on students' skill levels, classroom practices, and teachers' perceptions of creativity and innovation in mathematics education. Findings indicate a significant difference between students in high-impact and low-impact classrooms, with those in the former demonstrating higher creativity and innovation skills. Findings further indicate that teachers' perceptions of creativity-integrated mathematics instruction have a significant positive effect on their creative classroom practices. Recommendations included teacher training, resource development, and policy support for creativity in special education. Findings contribute to the global discussion on the need for creativity, innovation, and inclusion in special education by providing empirical insights into how creative-integrated mathematics instruction can mediate creative thinking, creative problem-solving, engagement, and influence teachers' classroom practices for students with special needs.

**Keywords:** creativity; innovation; inclusion; mathematics; special education; creative-integrated instruction; problem-solving

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**JEL Classifications:**

**Additional disciplines:** educology

## 1. Introduction

Creativity and innovation in special education include the use of flexible learning and technology to enable students with diverse needs to develop skills and collaborate during learning (Ovibiagbonhia et al., 2019). Though creativity is often associated with art subjects, the current school system is shifting towards productivity, harnessing creativity and innovation (Basic et al., 2021). Mathematics education is a critical foundation for such impact; however, most teachers avoid ideas outside the planned curriculum, such as creativity. Despite some teachers' avoidance of creativity, education fosters creative and innovative skills, which can be rated as high, moderate, or low. Creativity and innovation are important for the development of a knowledge-based society, which can improve the quality of life of individuals and social and educational needs (Norfarahi et al., 2020). Zaremohzzabieh et al. (2025) reported that a technology intervention focused on creativity in education had a

significant effect on students' learning. Golinkoff and Hirsh-Pasek (2016) argue that, to redefine success in the 21st century, collaboration and creativity must be included. They explained that creativity and innovation help transform knowledge by generating new knowledge in new areas. Within this context, creativity is understood as rearranging the old to create the new, while innovation is the value added to products or processes when incorporated into learning.

Mathematics education in South Africa faces challenges, including low levels of critical thinking, low achievement rates due to teaching approaches, and low student engagement. Creativity can inform ideas, thinking, and learning styles, thereby creating something new in the learning process (Norfarahi et al., 2020). Creativity and innovation can enhance mathematics learning, foster students' motivation, and problem-solving skills if used (Narayanan, 2017). Creativity and innovation in education, if recognised as key skills, can enable talented and other children to adapt adequately to the demands of modern society. With the realisation that creativity can be learned, the key to supporting creativity is shifting toward inclusive learning, including special education.

According to Govindasamy et al. (2023), students with special needs in special schools are those certified by medical doctors as visually impaired, speech impaired, having physical disabilities, or having learning difficulties. All students can learn to be creative and adventurous, to develop working theories about their world, and to make decisions about themselves as learners (Ari, 2017). Students with special needs can be encouraged to participate in creative activities to ensure they do not miss out on the education system, and to collaborate with peers and students without special needs. A high level of creativity is essential for acquiring the skills required in today's world.

According to Beresford-Dey et al. (2022), creativity enhances collaboration (including trust, knowledge flow, and groupthink), problem-solving, disrupting the status quo, risk-taking (including failure and experimentation), and openness (including flexibility and adaptability). For creativity and innovation to flourish, encouragement is needed to enhance experimentation alongside reducing limitations. Similarly, there has been emphasis on the need for confidence, which, on the teachers' side, could stem from experience and knowledge, including that gained through continuous professional development. Teachers can foster new ideas in learning only through creativity and student-motivational teaching and learning strategies. Norfarahi et al. (2020) found that the art of creating or producing a new thing is initiated by students' knowledge, motivation, and the way they think and behave.

Motivated students set clear goals and have a sense of personalised learning, which enables them in creative problem-solving of real-world problems. Therefore, teachers need to develop these highly creative skills by guiding students to learn using student motivation approaches in mathematics, such as creativity-integrated instructions that use learning materials and objects for illustration, technology, interactive learning, class discussions, and the ability to relate mathematical ideas to real-world problem-solving. Khalid (2017) posits that problem-solving is one solution to many issues in learning mathematics and in enhancing creativity. Hence, there is a need for creative problem-solving in fostering creativity and innovation. For teachers to use creative motivational approaches to guide students toward knowledge, they need to improve their creative skills and beliefs about creativity and expand their understanding of creativity in teaching.

Though the significance of creative thinking is globally acknowledged in the learning of mathematics for all students, its implementation is challenged by a lack of an appropriate framework for teaching and learning. In mathematics education, one notable area of creative thinking is the proof of theorems, proof construction, and hypothesis formation (Demetriou et al., 2022). Creativity is often evident here as students think critically and produce knowledge while interacting with one another. Creativity and innovation are ways students collaborate, interact, and learn from each other, which aligns with constructivist theory. This study explores the impact of creativity and innovation in mathematics education for students with special needs.

## 2. Theoretical Framework

Vygotsky's (1978) social constructivist theory underscores this study, emphasising the critical role of social interaction and mediated learning in cognitive development. This theory posits that students construct knowledge through active engagement and interaction. Creativity and innovation are key aspects in knowledge construction and discovery, enabling students to develop mathematical ideas, concepts, and problem-solving skills. Central to this theory are several concepts, such as the Zone of Proximal Development (ZPD), which refers to the gap between what students can achieve independently and what they can achieve with the teacher's guidance.

This framework is relevant to the present study because it highlights how instructional support and collaborative engagement can enhance students with diverse needs' understanding of mathematics concepts in an inclusive classroom setting. This theory also emphasises scaffolding, the need for students with moderate and low creative skills to be supported by the teachers and others who have acquired high problem-solving skills. High-level skills can be enhanced through resilience in continuous trial-and-error, eventually leading to knowledge constructed, discovered, created, or invented. Also, students can be assisted in discovering mathematical knowledge for problem-solving.

## 3. Literature Review

Studies provide evidence that creativity and innovation play a crucial role in students with special needs' learning of mathematics. That support involves diverse approaches, including fostering creativity and the ability to invent new mathematical ideas (Maoqqa & Buka, 2025).

### *Creativity*

Creativity in education aims to empower students to learn what is not original in their domain and to do better in situations they encounter through education. Creativity is conceptualised as a skill that can be developed but can also be inhibited. Šemberger and Konrad (2022) opine that creativity is a general human characteristic. Therefore, the stakeholders in education have the power to unlock children's creative potential, addressing creative learning and innovative teaching. Thus, creativity is a product and a process that expresses the balance between originality and value. In other words, it is the ability to make unexpected and original connections and generate new and relevant ideas. However, many students do not experience the excitement of creativity in learning due to teachers' insistent use of pedagogies that do not encourage creativity and see it as time-consuming (Elliott, 2018). Creative activities involve awareness, logic, and critical thinking and improve students' thinking skills. Hence, Beresford-Dey et al. (2022) assert that creativity is a carefully orchestrated effort to generate novel ideas, processes, and products that are of value to the school or system, leading to enhanced pupils' outcomes and life chances. Though creativity is closely connected to knowledge and learning, most students lack prior knowledge or practical experience relevant to becoming more creative.

### *Innovation*

To innovate is to look beyond what we are currently doing and develop a novel idea that helps us to do our job in a new way (Zhou, 2018). Innovation in STEM education is a multidimensional concept that generates new ideas; however, this is not the case in most special schools, where students with special needs are seen as having lower cognitive capacity (Maoqqa & Buka, 2025). Innovation connotes a device, program, method, process, or production that can be used to achieve improved conditions that bring about improvements. In education, particularly in special education, some innovations have emerged to boost motivation, improve the quality of thinking, and the educational process, thereby introducing novelty into the curriculum. Much of the curriculum content, objectives, learning experiences, methodology, and instructional materials have become obsolete, losing relevance due to the absence of inventions. These curriculum contents no longer address students' diverse physical and learning needs, nor social issues; hence, the need to revise them and integrate creativity in the

teaching approaches. Educational innovation concerns all stakeholders: the learner, parents, teachers, educational administrators, researchers, and policy makers, and requires their active involvement and support.

#### *Creativity-integrated instruction*

Saied (2016) emphasises that mathematics is a subject whose abstract nature makes it boring and difficult to understand, and that it requires a motivational approach in its teaching for learning to take place, especially for students with special needs. It's difficult to teach mathematics to students with special needs; therefore, teachers need to use motivational strategies such as Creativity-Integrated Instruction (CII). Khalid et al. (2020) argue that motivational approaches can foster creative ability through discussions and hands-on problem-solving. The inclusion of technology creates a motivating environment for learning, seeking information, and acquiring knowledge (Beghetto, 2017). This can foster a creative environment for students with special needs as they use technology, discuss among themselves, and figure out ways to solve mathematical problems, with all students actively participating in the mathematics classroom. Technology contributes to more constructivist, creative learning and to greater student activity and responsibility in the classroom (Chanda & Sain, 2024). The use of technology influences students' motivation to learn, and CII reinforces this. Naidoo and Kapofu's (2020) research shows that when innovative learning is introduced in the classroom, using objects for illustration, fostering interactions and discussions, and having learners actively participate make learning mathematics more interesting, hence, enhancing creativity. This highlights new ideas aimed at solving problems, a feature of mathematics. The teacher can integrate creativity using questions, objects, and illustrations that encourage students to think creatively and innovatively to proffer solutions. Kosasih et al. (2022) note that the knowledge taught and the material learned facilitate students' understanding of mathematical concepts. For example, learning geometry cannot be separated from the use of shapes and objects. This ensures that the geometry concept is taught in the context of real-life problems, boosting students' interest and engagement. According to Arthur et al. (2018), relating mathematics to real-life problems is a teaching quality that fosters learners' interest in mathematics concepts. When teachers can connect different types of mathematical knowledge to real-world problems and experiences, they can make mathematics lessons more engaging, creative, and innovative.

#### *Creative Problem-solving*

Creativity is an important component of problem-solving and cuts across all forms of problems; it's an unusual ability to offer solutions to math-related problems (Kaplan, 2019). Though creativity is regular in teaching arts subjects, its significance lies in how it is being integrated into learning mathematics. The fostering of creativity in the learning of mathematics through problem-solving is a major way to show creativity (Khalid et al., 2020). Teachers can guide students to create hands-on activities for learning mathematics that can be used to solve problems (Bicer et al., 2024). Students can be presented with open questions, which enable them to think creatively, as creativity in mathematics is evident in the discovery of original ways to solve unusual mathematical problems (Saied, 2016). Problem-solving can promote creativity in mathematics and eliminate mathematics phobia and rote learning, which can make mathematics lessons abstract to students, especially those with special needs (Khalid et al., 2020). Khalid's (2017) study, which measured through a collaborative problem-solving strategy in Malaysia, suggested that creative problem-solving enhances students' creativity. Also, Hu et al.'s (2017) study on the application of creative problem-solving to statistics instruction found that students' mathematics learning has a strong foundation through problem-solving as they collaborate and interact, learning from one another.

#### *Creative Thinking*

Zhao and Abdullah (2025) emphasise that fostering creative thinking in students is an essential skill for developing innovative mathematical problem-solving. Creative thinking involves students developing novel approaches to solving problems (Khalid et al., 2020). The teacher's role is to guide students as they learn the mathematical content appropriate to their current stage of learning, using creativity as a well-planned learning adventure in mathematics, constructed to enable students with special needs to relate mathematical ideas to

solving real-world problems. Eya and Eya (2022) explain that, apart from digital education, some educational systems are not good, downplaying character, values, skills, and creativity; hence, they emphasise that education should be the training of the human mind to think creatively. However, the opportunity for creativity in the classroom is limited. Beghetto (2017) asserted that students' creative thinking can be enhanced by teachers' confidence in guiding students towards creative thinking and idea construction, as well as by environmental factors that foster creativity. Such an environment can be a creative classroom where students interact and share knowledge as they think creatively and actively engage in learning.

#### *Teachers' Perception of Creative Learning*

One of the three Robinson's (2017) myths emphasises that creativity is 'reserved' for specific areas of individual activity, such as the arts. Fostering creativity in students is the top priority in teaching and learning. This highlights questions such as: what kind of classrooms must we create to complete this great task? Do we still believe that creativity is a trait you are born with and carry into the classroom? Can teachers teach their students to be creative? However, despite recommendations to incorporate creativity in schools, many teachers still do not believe in the relevance of nurturing creativity in their students, nor do they know how best to foster it in their classrooms (Lasky & Yoon, 2020). Over the last several years, researchers have concluded that teachers need to revise their expectations for the kind of creativity they can expect from their students.

Teachers who believe in their students' creative ability see it more as a personal trait inherent in some students, rather than something that can be taught in the classroom, believing that creativity may have no place in today's classrooms, as they feel too strapped for time trying to meet curricular standards to worry about creativity (Elliott, 2018). According to Lasky and Yoon (2020), teachers find it challenging to implement a creativity pedagogy because they often lack a lens for understanding creativity in their classrooms. However, creativity is not a mystical process for a select few or a trait inherent in specific learners; it is part of an inclusive learning process for all students in the mathematics classroom. According to Lasky and Yoon (2020), a creativity-integrated instruction class is one in which the teacher accepts students' divergent thinking, promotes collaboration in small groups, and increases learning and self-confidence. Teachers' creative teaching and classroom practices can foster students' creativity and highly innovative skills. Teachers can foster creativity through teaching strategies and approaches that, in turn, can enhance students' creativity across low, moderate, and high skill levels. As teachers generate new ideas, students are motivated to realise their potential in creativity and innovation (Adibah & Hafiza, 2021).

#### **4. Statement of the Problem**

Mathematics education in African countries like South Africa faces challenges, and creativity and innovation are essential for improving learning experiences. Most studies have focused on general pedagogy in mathematics learning rather than on integrating creativity to enable its application in real-world problem-solving and innovation. Mathematics education in South Africa is challenged by limited access to resources, large class sizes, and inadequate teacher training, which can hinder creativity in the classroom. To foster creativity and innovation, teachers need to improve their creative skills and beliefs about creativity, and to use creative-integrated instruction to guide students in generating ideas and improving their mathematics learning. Limited research exists on effective creative-integrated mathematics instruction, with the mythical perception that creativity and innovation should be reserved for the arts subjects. This makes it difficult to introduce creativity and innovation in the mathematics classroom, especially for students with special needs. Against this background, the present study investigates the impact of creativity and innovation in mathematics education for students with special needs. It addresses the need to explore creativity and innovation in mathematics education by integrating them into instruction to foster them, creating a clear, inclusive learning environment for students with special needs to express their creative thinking and learning skills as they solve real-world problems.

*Purpose of the Study*

The purpose of this study is to examine the impact of creativity and innovation in mathematics education for students with special needs education, grounded in Vygotsky's social constructivist theory. The study seeks to determine how creativity and innovation can be effectively integrated to support mathematics education for students with special needs. Specifically, the study aims to achieve the following objectives:

1. To examine the impact of creativity-integrated mathematics instruction on students' mathematics problem-solving across skill levels.
2. To explore teachers' perceptions of the role of creativity and innovation in mathematics education and how these perceptions influence their teaching practices.

*Research Questions*

The study is guided by these research questions:

1. What is the difference in creativity and innovation skills among students in high, moderate, and low creativity-integrated mathematics classrooms?
2. What is the level of teachers' perceptions of creativity-integrated mathematics instruction for students with special needs?

*Hypotheses*

The following hypotheses were formulated based on these research questions and tested at the .05 level of significance.

1. There is no significant difference in creativity and innovation skills among students in high-, moderate-, and low-creativity-integrated mathematics classrooms.
2. Teachers' perceptions of creativity-integrated mathematics instruction do not significantly influence their creative classroom practices.

**5. Materials and Methods***Research Paradigm*

This study aims to examine the impact of creativity and innovation on mathematics learning in special education. The study is grounded in the philosophical assumption of pragmatism, which emphasises the practical application of ideas and the use of multiple creative methods to address real-world problems. Pragmatism supports integrating both quantitative and qualitative approaches, focusing on outcomes with meaningful implications for teaching and learning. In line with this orientation, this study focuses on the practical outcomes of creativity-integrated mathematics instruction across high, moderate, and low skill levels for students with special education needs. The study employed a mixed-methods design to provide a comprehensive understanding of the impact on student motivation, creative thinking, and problem-solving in mathematics among students with special needs. It also measures teachers' perceptions, experiences with creativity-integrated instruction, and practices. Quantitative data provide measurable evidence of improvement in creative skills in mathematics. In contrast, qualitative data offer insights into teachers' perceptions, influencing their classroom practices through creativity-integrated instruction in mathematics for special education.

*Research Design*

The study used a mixed-methods design to investigate the impact of creativity-integrated mathematics instruction on grade 8 students' creative problem-solving skills and learning outcomes in mathematics. It aims to measure the impact of creativity-integrated mathematics instruction on students' creativity and innovation across skill levels of high, moderate, and low. It also aims to explore teachers' perceptions of creativity-integrated instruction in special schools in the Gauteng Province of South Africa. This design was chosen because it enables the collection of data on participants' perceptions and experiences from which generalisations can be made to the larger population (Drushlyak et al., 2023). It fosters both quantitative measurement and qualitative evidence on participants'

experiences, ensuring practical impact and a theoretical contribution to understanding how creativity-integrated mathematics instruction can enable creative problem-solving skills and influence teachers' practices.

### *Population and Sample*

The target population comprises 92 grade 8 students and 10 mathematics teachers from 5 special schools in Gauteng, South Africa. Purposive sampling was used to select special education classes and their teachers who use creativity-integrated instruction. The selected teachers had at least 1 year of experience integrating creativity into their mathematics teaching. The Grade 8 students, aged 13 to 15, participated in this research. This age is slightly higher than the typical grade 8 age of 13-14 because some students with special needs do not start school at the typical school age. To ensure representativeness, stratified random sampling was used to group schools according to geographical location, followed by cluster sampling to select classes within each school. From these clusters, participants were chosen proportionally to school location diversity. This sampling strategy ensured that measurements were taken at all schools and across a range of learning contexts. For the observation sessions, 4 mathematics teachers were purposefully selected to be observed in class to note the creative practices they employ while teaching the students. Such methodological triangulation is recommended for quantitative studies examining instructional practices in inclusive environments.

### *Instruments*

Data were collected using two instruments designed by the researcher: the Creativity and Innovation Mathematics Students' Questionnaire (CIMSQ) and the Creativity-Integrated Mathematics Instruction and Practices Questionnaire (CIMITPQ). CIMSQ contained 17 items designed to capture how integrating creativity and innovation into mathematics instruction affects students with special needs' creative problem-solving skills. CIMITPQ contained 30 items that captured teachers' perceptions of how creativity-integrated mathematics influences students' creativity and innovation, creative problem-solving skills in mathematics, and teachers' teaching practices. Each questionnaire made use of the four-point Likert-type scale (Strongly Agree = 4; Agree = 3; Disagree = 2; Strongly Disagree = 1).

The instruments covered creative thinking (1-9), creative problem-solving skills in mathematics (10-17), and items (1-8) on the students' questionnaire. For the teacher's questionnaire, (1-10) focused on developing creativity-integrated mathematics instruction for special needs, (11-18) on teachers' perceptions of creativity-integrated mathematics instruction, (19-23) on teachers' experiences with creativity-integrated instruction, and (24-30) on teachers' creative classroom practices. In addition, classroom observation with a focus on teaching approaches, student engagement, task design that involves creative thinking, and the expression of problem-solving skills in assessment and feedback, was also conducted. This was carried out by the researcher during learning sessions to capture the practical application of creativity-integrated mathematics instruction by mathematics teachers in the classroom. The researcher observed four mathematics teachers implementing creativity-integrated instruction and recorded students' responses to tasks that required creative thinking and problem-solving. During the classroom observation sessions, the researcher was able to group the classrooms into three categories based on their total observation scores (high, moderate, and low-impact classrooms).

The 'high-impact,' 'moderate-impact,' and 'low-impact' classrooms refer to the degree to which teachers implemented creativity-integrated instructional strategies during mathematics lessons. High-impact classrooms were characterised by frequent use of open-ended problem-solving tasks to ensure creative thinking. Also, student-centred inquiry, opportunities for multiple solutions and problem-solving, and encouragement of original thinking. Moderate-impact classrooms incorporated some of these elements, but with less consistency or depth. Here, teachers occasionally used open-ended questions to enable creative thinking, but lessons were still partly guided by traditional, structured instruction. In contrast, low-impact classrooms, also known as low creativity-integrated classrooms, predominantly used traditional teacher-directed approaches and focused on single-solution, procedural tasks. This class gave limited opportunities for student exploration, original thinking, and discussion.

### *Validity and Reliability*

Specialists in mathematics education and educational technology evaluated the questionnaires for clarity, content relevance, and alignment with the study objectives. Based on the feedback, modifications were made to enhance construct validity. The scientific quality of this study was ensured by careful adherence to established quality criteria for quantitative and qualitative research. In terms of quantitative rigour, validity, and reliability were addressed using previously validated instruments, consistent administration procedures, and appropriate statistical analyses aligned with the research questions. Internal consistency was examined to ensure the stability of the measured constructions. Reliability was assessed using Cronbach's alpha, yielding coefficients of 0.90 for the CIMSQ and 0.93 for the CIMITPQ. The instruments were considered reliable for data collection, since their values exceeded the minimum acceptable threshold of 0.50, confirming satisfactory internal consistency.

Regarding the qualitative components, credibility was supported through classroom observations, teaching approaches, student engagement, task design that involves creative thinking, and the expression of problem-solving skills in assessment and feedback. The researcher's comments on the classroom observation were used to verify the questionnaire analysis results and to support or contradict them during discussion. Furthermore, the study's limitations, particularly those related to the teacher sample size, contextual specificity, and analytical scope, were explicitly acknowledged, thereby strengthening the trustworthiness and interpretive boundaries of the findings.

### *Data Collection Procedure*

Prior to data collection, permissions were obtained from school authorities. Teachers and students administered questionnaires directly during class sessions according to the school schedule, and participation was voluntary. The classroom observation covers teaching approaches, student engagement, task design, creative thinking, problem-solving skills, and feedback. Creativity-integrated instruction was selected as a student motivation learning approach that can facilitate motivation, creative thinking, and creative problem-solving skills in mathematics for students, and as a teacher motivational teaching approach for teachers' perceptions, experiences, and creative classroom practices.

Creativity-integrated instruction is appropriate for fostering creativity in mathematics among grade 8 students by enabling motivation, creative thinking, and creative problem-solving. Data was collected for a period of three weeks for the study. Regarding quantitative measurement, CIMSQ and CIMITPQ were administered to teachers and students. This captured their perceptions of creativity-integrated instruction on students' engagement, creative thinking, creative problem-solving skills in mathematics, experiences, and teachers' creative classroom practices. The researcher recorded the classroom observation schedule in four schools during mathematics lessons.

### *Data Analysis*

Quantitative data were analysed using descriptive and inferential statistics through the Statistical Package for Social Sciences (SPSS, version 26). Descriptive statistics, including mean scores, frequencies, and standard deviations, were used to answer the research question, thereby summarising demographic data and responses to individual items. Analysis of Variance (ANOVA) was used to assess differences in skill levels, and the post-hoc Tukey's HSD test was used to determine significant interactions within skill levels. At the same time, regression analysis examined predictors of the learning outputs. The significance level was set at 0.05. Data was analysed mathematically, impact/perception was categorised into three levels by dividing the 4-point Likert scale ( $4 - 1 = 3$ ) into three equal intervals, yielding an interval width of 1.

Based on this classification, mean scores of 3.00–4.00 were interpreted as high impact or perception, 2.00–2.99 as moderate impact or perception, and 1.00–1.99 as low impact or perception. Classroom observation data were subjected to thematic analysis, which identified recurring themes that complemented and contextualised the quantitative results. Coding procedures were applied to categorise statements into themes such as teaching

approaches, student engagement, task design, creative thinking, problem-solving skills, and feedback. This mixed-analytic approach enhanced the credibility, dependability, and confirmability of the results by triangulating multiple data sources.

### *Ethical Considerations*

Ethical standards were strictly observed throughout the study. Institutional approval was obtained from the Ethics Review Committee of the College of Education, University of South Africa (UNISA) under ref number 16/04/2026 to 16/04/2029 (Ref #:11588) for data collection. Informed consent was obtained from the school authorities on behalf of the participants, and confidentiality was maintained by anonymising the students' names and those of their mathematics teachers. Participants were assured that their responses would be used solely for academic purposes and would not affect their professional or academic standing.

## 6. Results

The results of the study are presented in order of the research questions and hypotheses as follows:

**Research Question 1:** What is the difference in creativity and innovation skills among students in high, moderate, and low creativity-integrated mathematics classrooms?

**Table 1.** Mean and Standard Deviation of the Impact of Creativity-Integrated Mathematics Instruction on Mathematics Creativity and Innovation Skills of Students

| Creativity-Integrated Mathematics Instruction | N         | $\bar{x}$   | SD          |
|-----------------------------------------------|-----------|-------------|-------------|
| High Impact                                   | 30        | 3.11        | 0.38        |
| Moderate Impact                               | 28        | 3.00        | 0.28        |
| Low                                           | 34        | 2.51        | 0.55        |
| <b>Total</b>                                  | <b>92</b> | <b>2.87</b> | <b>0.40</b> |

Table 1 shows that students in classrooms with a high level of creativity integration recorded the highest mean score ( $\bar{x} = 3.11$ ,  $SD = 0.38$ ), indicating that they demonstrate stronger creativity and innovation skills compared to their peers. The relatively low standard deviation suggests that these skills are consistent among students in this group. Those in moderately integrated classrooms showed a slightly lower mean score ( $\bar{x} = 3.00$ ,  $SD = 0.28$ ). While their performance is still relatively strong, it does not reach the level observed in highly integrated settings. However, the smaller standard deviation indicates that students' scores in this group are more tightly clustered, reflecting greater uniformity in their skill levels.

In contrast, students exposed to a low level of creativity integration had the lowest mean score ( $\bar{x} = 2.51$ ,  $SD = 0.55$ ), suggesting weaker creativity and innovation skills. The higher standard deviation here indicates greater variability among students, suggesting that their skill levels are less consistent and more widely dispersed. This implies that integrating creativity into mathematics instruction is beneficial, and even moderate integration can make a meaningful difference, but low integration is clearly inadequate.

**Research Question 2:** What is the level of teachers' perceptions of creativity-integrated mathematics instruction for students with special needs?

**Table 2.** Mean and Standard Deviation of Teachers' Perceptions of Creativity-Integrated Mathematics Instruction for Students with Special Needs

| S/N                                        | Item Description                                                                                                        | n  | $\bar{x}$   | SD          | Remark   |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----|-------------|-------------|----------|
| 11                                         | Creativity-integrated mathematics instruction improves students' understanding of mathematics ideas.                    | 10 | 3.00        | 1.05        | High     |
| 12                                         | Mathematics should not be taught through creativity, as it is not an art subject.                                       | 10 | 3.20        | 1.23        | High     |
| 13                                         | Students encounter difficulties using creativity-integrated mathematics instruction to learn mathematics ideas          | 10 | 3.00        | 0.94        | High     |
| 14                                         | Creativity is an important component of learning mathematics                                                            | 10 | 2.80        | 1.23        | Moderate |
| 15                                         | Encouraging creativity using creativity-integrated mathematics instruction helps students become better problem solvers | 10 | 3.10        | 0.99        | High     |
| 16                                         | The use of creativity in integrated mathematics instruction helps students think creatively as they solve problems.     | 10 | 2.70        | 0.82        | Moderate |
| 17                                         | Creativity-integrated mathematics instruction is time-consuming in the mathematics classroom                            | 10 | 2.40        | 1.17        | Moderate |
| 18                                         | Creativity-integrated mathematics instruction helps students relate mathematics to real-world problem-solving           | 10 | 3.20        | 0.63        | High     |
| <b>Cluster Mean and Standard Deviation</b> |                                                                                                                         |    | <b>2.93</b> | <b>1.01</b> | Moderate |

Table 2 shows that the items recorded mean scores that fall within the moderate and high perception levels based on the classification (3.00–4.00 = high, 2.00–2.99 = moderate, 1.00–1.99 = low). Items with high mean scores include Item 11, which indicates that creativity-integrated mathematics instruction improves students' understanding of mathematics ideas ( $\bar{x} = 3.00$ ,  $SD = 1.05$ ); Item 12, which shows that mathematics should not be taught through creativity, as it is not an art subject ( $\bar{x} = 3.20$ ,  $SD = 1.23$ ); Item 13, which reflects that students encounter difficulties using creativity-integrated mathematics instruction to learn mathematics ideas ( $\bar{x} = 3.00$ ,  $SD = 0.94$ ); Item 15, which states that encouraging creativity using creativity-integrated mathematics instruction helps students become better problem solvers ( $\bar{x} = 3.10$ ,  $SD = 0.99$ ); and Item 18, which shows that creativity-integrated mathematics instruction helps students relate mathematics to real-world problem-solving ( $\bar{x} = 3.20$ ,  $SD = 0.63$ ). These high mean scores indicate that teachers strongly perceive both the benefits and some challenges associated with creativity-integrated mathematics instruction.

On the other hand, some items fall within the moderate perception range. These include Item 14, which shows that creativity is an important component of learning mathematics ( $\bar{x} = 2.80$ ,  $SD = 1.23$ ); Item 16, which indicates that the use of creativity in integrated mathematics instruction helps students think creatively as they solve problems ( $\bar{x} = 2.70$ ,  $SD = 0.82$ ); and Item 17, which reflects that creativity-integrated mathematics instruction is time-consuming in the mathematics classroom ( $\bar{x} = 2.40$ ,  $SD = 1.17$ ). These moderate mean scores suggest that teachers are somewhat convinced about these aspects but not strongly so.

The mean scores ranged from 2.40 to 3.20, indicating a mix of moderate and high perceptions among teachers, while the standard deviation values (0.63 to 1.23) show moderate variability in responses. The cluster mean of 2.93 falls within the moderate perception range, indicating that teachers generally perceive creativity-integrated mathematics instruction for students with special needs as moderate. The cluster standard deviation of 1.01 further suggests some variation in opinions. By implication, teachers' perceptions are moderately positive, with stronger agreement on certain benefits and concerns surrounding the implementation of creativity-integrated instruction.

**Hypothesis 1.** There is no significant difference in creativity and innovation skills among students in high-, moderate-, and low creativity-integrated mathematics classrooms.

**Table 3.** Summary ANOVA on Impact of Creativity-Integrated Mathematics Instruction on Mathematics Creativity and Innovation Skills of Students

|                | Sum of Squares | Df | Mean Square | F      | Sig. |
|----------------|----------------|----|-------------|--------|------|
| Between Groups | 6.751          | 2  | 3.375       | 18.263 | .000 |
| Within Groups  | 16.449         | 89 | .185        |        |      |
| Total          | 23.200         | 91 |             |        |      |

Table 3 shows that  $F(2,89) = 18.263$ ;  $p = 0.000 < 0.05$ . Thus, the null hypothesis is rejected. This moderate and low-creativity-integration implies that there is a significant difference in students' creativity and innovation skills across high, moderate, and low-creativity-integration mathematics classrooms. Therefore, the level of creativity-integrated instruction significantly influences students' creativity and innovation skills, indicating that the groups do not perform equally. The effect size (partial eta squared) can be estimated as  $6.751/23.200 \approx 0.291$ , indicating that about 29.1 per cent of the variation in students' creativity and innovation skills is explained by the level of creativity-integrated mathematics instruction. This represents a large effect size, suggesting a substantial impact of instructional approach on students' creativity and innovation skills. This is supported by the classroom observation in terms of students' engagement and creative thinking.

**Table 4.** Post Hoc Test on Impact of Creativity-Integrated Mathematics Instruction on Mathematics Creativity and Innovation Skills of Students

| (I) Creativity-Integrated Mathematics Instruction | (J) Creativity-Integrated Mathematics Instruction | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval |             |
|---------------------------------------------------|---------------------------------------------------|-----------------------|------------|------|-------------------------|-------------|
|                                                   |                                                   |                       |            |      | Lower Bound             | Upper Bound |
| High Impact                                       | Low Impact                                        | .60681*               | .10769     | .000 | .3501                   | .8635       |
|                                                   | Moderate Impact                                   | .10952                | .11297     | .598 | -.1597                  | .3788       |
| Moderate Impact                                   | Low Impact                                        | .49728*               | .10971     | .000 | .2358                   | .7588       |

Table 4 shows the results of the post hoc analysis on the impact of creativity-integrated mathematics instruction on students' creativity and innovation skills. The findings indicate a significant difference between students in the high-impact and low-impact classrooms (Mean difference = 0.60681,  $p = 0.000 < 0.05$ ), with students in the high-impact classrooms demonstrating higher creativity and innovation skills. However, there is no significant difference between students in the high-impact and moderate-impact classrooms (Mean difference = 0.10952,  $p = 0.598 > 0.05$ ), indicating that their creativity and innovation skills are comparable.

Furthermore, a significant difference exists between students in the moderate-impact and low-impact classrooms (Mean difference = 0.49728,  $p = 0.000 < 0.05$ ), with the moderate-impact group demonstrating higher creativity and innovation skills than the low-impact group. By implication, students exposed to high- and moderate-levels of creativity-integrated mathematics instruction developed creativity and innovation skills significantly better than those in low-impact classrooms. In contrast, the difference between high and moderate levels is not statistically significant.

**Hypothesis 2.** Teachers' perceptions of creativity-integrated mathematics instruction do not significantly influence their creative classroom practices.

**Table 5.** ANOVA of Regression Analysis of Teachers' Perceptions of Creativity-Integrated Mathematics Instruction and Creative Classroom Practices

| Model |            | Sum of Squares | df | Mean Square | F      | Sig.              |
|-------|------------|----------------|----|-------------|--------|-------------------|
| 1     | Regression | 2.146          | 1  | 2.146       | 36.619 | .000 <sup>b</sup> |
|       | Residual   | .469           | 8  | .059        |        |                   |
|       | Total      | 2.614          | 9  |             |        |                   |

The ANOVA results indicate that teachers' perceptions of creativity-integrated mathematics instruction have a significant positive effect on their creative classroom practices (see Table 5 above). The regression model is statistically significant,  $F(1, 8) = 36.619$ ,  $p < 0.001$ , indicating that the likelihood of this relationship occurring by chance is extremely low. The model explains a substantial portion of the variance in creative classroom practices, with an  $R^2$  of 0.821, indicating that approximately 82.1% of the variation in teachers' creative practices is accounted for by their perceptions of creativity in mathematics instruction. This demonstrates that teachers' perceptions are a strong and meaningful predictor of their creative teaching behaviours.

## 7. Discussion

The study results reveal the relationship between high, moderate, and low creativity and innovation skills. High, moderate, and low creativity-integrated classrooms demonstrated the extent to which teachers, in their lessons, emphasised open-ended problem-solving, encouraged creative thinking through mathematics tasks, and enhanced student participation, engagement, and collaboration with high-integration classrooms and moderate integration-classrooms showing these features most consistently. While low-integration classrooms mostly use the least, they use a traditional, structured, teacher-centred instructional approach.

The findings indicate a significant difference between students in high-impact and low-impact classrooms, with those in the former demonstrating higher creativity and innovation skills. Hence, the null hypothesis is rejected, as there is a significant difference between the students with high and low creativity and innovation skills. This implies that creativity-integrated instruction significantly influences students' creativity and innovation skills, indicating that the groups do not perform equally. Despite the result that there is no significant difference between students in the high-impact and moderate-impact classrooms, indicating that their creativity and innovation skills are comparable, the partial eta squared of 0.291 indicates that the level of creativity-integrated mathematics instruction explains 29.1% of the variation in students' creativity and innovation skills. This represents a large effect size, suggesting a substantial impact of instructional approach on students' creativity and innovation skills.

The findings indicate comparativeness between high-impact and moderate-impact creativity-integrated classrooms. This implies that, to keep creativity relevant, its implementation may take different forms, such as more structured inquiry, guided problem-solving, or strategically chosen open tasks rather than completely open-ended exploration, as in a high-impact creativity-integrated classroom. This means that, rather than creativity being less important, it is about balancing cognitive knowledge weight or load and time constraints while ensuring creativity; hence, the teacher's implementation of creativity may be presented in different ways, hence the high, moderate, and low creativity integrated instruction. This finding agrees with Adibah and Hafiza's (2021) position that as teachers generate new ideas, students are motivated to realise their potential in creativity and innovation. Hence, creativity and innovation are important in learning, both when the curriculum is simpler or more complex;

the teacher's approach to teaching enables conceptual understanding and enhances creativity. This shows that the teachers' creative approaches and knowledge presentation are also important for learning both complex and simple concepts.

This finding aligns with constructivist theory, which emphasises the role of social interaction and students' knowledge discovery, enabling them to develop mathematical ideas and skills as they collaborate with others. This supports learning and emphasises scaffolding, enabling students with moderate and low skills to learn and be supported by those with highly creative learning skills in mathematics, conceptual understanding, and problem-solving. This agrees with Golinkoff and Hirsh-Pasek (2016), who argued that creativity, innovation, and collaboration must be part of learning and can be enhanced by support from teachers, peers, and parents. This finding aligns with those of Norfarahi et al. (2020), Ovibiagbonhia et al. (2019), Uranta and Akpan (2019), Zaremohzzabieh et al. (2025), and Zhou (2018), all of whom found that creativity and innovation make learning more flexible, enable students with special needs to develop learning skills and ideas, and improve the quality of life for individuals. Hence, the need for teachers to inculcate creative, integrated, and innovative teaching and learning in the development of mathematical skills, and to encourage classroom interaction and collaboration during learning.

The study results further reveal that teachers' perceptions of creativity-integrated mathematics instruction have a significant positive effect on their creative classroom practices. The regression model is statistically significant, indicating that the likelihood of this relationship occurring by chance is extremely low. Hence, 82.1% of the variation in teachers' creative practices is accounted for by their perceptions of creativity in mathematics instruction. This finding contradicts Robinson's (2017) myth that creativity and innovation should be reserved for art subjects, also Elliott, (2018), and Lasky and Yoon (2020) who argued that incorporating creativity and innovation in teaching is time consuming and most teachers do not know how best to foster it in their classrooms, even though it can enable inclusive learning especially for students with special needs. This shows that teachers have a change in perspective, enabling them to incorporate creativity and introduce new ideas into mathematics and science subjects, enhancing the development of learning skills in mathematics towards real-world problem-solving, which is one of the major roles of creativity and innovation, as it aligns with (Adibah & Hafiza, 2021).

This finding aligns with Maqoqa and Buka (2025), who argue that students require teacher support to be creative, but that teachers can only support creativity and innovation if they have a positive perspective on them. This finding agrees with Chanda and Sain (2024), and Khalid et al. (2020), who posit that the use of motivational strategies and technology in teaching can foster creativity and innovation in students towards real-world problem-solving. The teacher's perspective is very important in creative learning, as teachers can use learning materials to foster students' creativity in mathematics, particularly in geometry. This agrees with Arthur et al. (2018), Kosasih et al. (2022), and Naidoo and Kapofu's (2020), who reveal that learning can be introduced creatively in the classroom using learning materials, the use of objects, or illustrations, which enable mathematics concepts to be taught in the context of real-life problems.

## 8. Recommendations

Based on the observations in this paper, the following recommendations are made:

1. Teachers should utilise creativity and innovation to provide effective education for students with special needs by actively engaging students in lessons to enhance learning outcomes.
2. Intensive in-service programs should be organised to enable special education teachers to become acquainted with and trained in effectively utilising creativity and innovation in teaching.
3. Teachers and principals should be encouraged to become more creative in their teaching.

### Limitations

The following are limitations to the study: classroom size, teacher-student ratio, and resource availability influenced the effectiveness of seating arrangements and communication skills. Classroom observations were constrained by time and, therefore, limited to a few participants.

## 9. Conclusions

This study investigates the impact of creativity and innovation in mathematics education for students with special needs. It explores creativity and innovation in mathematics education by integrating them into instruction and creating a clear, inclusive learning environment for students with special needs to express their creative thinking and learning skills in solving real-world problems. The study is informed by social constructivist theory, which emphasises that knowledge is constructed and discovered through interaction, thereby facilitating inclusion and equity. The study provided empirical evidence to guide teachers and curriculum planners, and to inform educational policies, promoting creativity, innovation, and inclusiveness in mathematics education, particularly in special education.

Despite the myth that creativity and innovation have no place in mathematics education, the results affirm that the use of creative-integrated instruction can foster creative problem-solving skills for mathematically inclined real-world problems and improve students' creative skills. The study also shows that teachers' perceptions influence their incorporation of creativity-integrated instruction in teaching mathematics, and that special education teachers use it.

The study investigates creativity-integrated mathematics instruction across three levels of implementation: high, moderate, and low impact. The study's findings show that while both high and moderate levels of creativity integration significantly enhance students' creativity and innovation skills compared to low levels, there is no significant difference between high and moderate levels, suggesting a potential threshold effect. Also, the study provides empirical evidence of a strong link between teachers' perceptions and their creative classroom practices, highlighting the critical role of teacher beliefs and teachers' different presentations in shaping instructional approaches, as seen in the high and moderate-impact classrooms. By combining quantitative analysis with classroom-based observations, this study offers a more nuanced understanding of how varying degrees of creativity integration influence student outcomes.

Although the study participants were students with special needs, it fills an important gap in mathematics education by ensuring creativity and innovation in the classroom for all students. These findings, though specific to the study's participants with special needs, can be generalised to educational settings for students without special needs. These findings can be reasonably generalised to other students, as creativity-integrated instruction positively influences students' creativity and innovation skills, regardless of age, prior knowledge, knowledge context, or ability level.

Future studies should focus on technology-based creative modules for mathematics education in special schools. This should include a larger population of mathematics teachers in the sample.

## References

- Adibah, L. A., Hafizah, Z. (2021). The creativity practice of Islamic education teachers in the 21st century learning. *ASEAN Comparative Education Research Journal on Islam and Civilization*. 4(1), 40-54. <https://spaj.ukm.my/acerj/index.php/acer-j/article/view/67>
- Ari, C. O. (2017). Creativity and innovation in early childhood education: The role of educators. *Journal of Resourcefulness and Distinction*, 14(1), 1-14. <https://www.globalacademicgroup.com/journals/resourcefulness/Cecilia%20Ari.pdf>

Arthur, Y. D., Owusu, E. K., Asiedu-Addo, S., & Arhin, A. K. (2018). Connecting mathematics to real-life problems: A teaching quality that improves students' interest in mathematics. *IOSR Journal of Research & Method in Education*, 8(4), 65-71.

<https://www.iosrjournals.org/iosr-jrme/papers/Vol-8%20Issue-4/Version-2/J0804026571.pdf>

Basic, A., Parezanovic, R. Z., Gajic, A., Arsic, B., & Petrovic, M. D. (2021). Creativity in teaching math to students with intellectual disabilities. *International Journal of Innovation Education and Research* <https://doi.org/10.31686/ijer.vol9.iss6.3198> ISSN 2411-2933

Beghetto, R.A. (2017). Creativity in Teaching. In J.C. Kaufman, J. Baer, & V.P. Glăveanu (Eds.). *Cambridge Handbook of Creativity Across Different Domains* (pp. 549-564). New York: Cambridge University Press. <https://doi.org/10.1017/9781316274385.030>

Beresford-Dey, M., Ingram, R., & Lakin, L. (2022). Conceptualising Creativity and Innovation in the Role of Primary Sector Headteachers. *Education Sciences*, 12, 70-85. <https://doi.org/10.3390/educsci12020070>

Bicer, A., Aleksani, H., Butler, C., Jackson, T., Smith, T. D., & Bostick, M. (2024). Mathematical creativity in upper elementary school mathematics curricula. *Thinking Skills and Creativity*, 51, Article 101462. <https://doi.org/10.1016/j.tsc.2024.101462>

Chanda, C. T. & Sain, Z. H. (2024). Harnessing information communication technology in civiceducation teaching and learning: A comprehensive review. *Global Scientific Journal GSJ*, 12(4), 112-130. [https://www.globalscientificjournal.com/researchpaper/Harnessing Information Communication Technology in Civic Education Teaching and Learning A Comprehensive Review .pdf](https://www.globalscientificjournal.com/researchpaper/Harnessing%20Information%20Communication%20Technology%20in%20Civic%20Education%20Teaching%20and%20Learning%20A%20Comprehensive%20Review.pdf)

Demetriou, A., Spanoudis, G. C., Greiff, S., Makris, N., Panaoura, R., & Kazi, S. (2022). Changing priorities in the development of cognitive competence and school learning: A general theory. *Frontiers in Psychology*, 13, 954-971. <https://doi.org/10.3389/fpsyg.2022.954971>

Drushlyak, M., Semenikhina, O., Kharchenko, I., Mulesa, P., & Shamonina, V. (2023). Effectiveness of digital technologies in inclusive learning for teacher preparation. *Journal of Learning for Development*, 10(2), 177-195. <https://doi.org/10.56059/jl4d.v10i2.777>

Elliott, J. (2018). Buying in and selling out the commodification of creativity in the classroom. *Changing English: Studies in Culture and Education*, 25(4), 396-409. <https://doi.org/10.1080/1358684x.2018.1517021>

Eya, P. E., & Eya, G. M. (2022). Technology integration in repositioning education for sustainable youth empowerment and national development. *International Journal of Education, Library and Information Communication Technology IJELICT*, 1(1). <https://ijelict.acu.edu.ng/index.php/ijelict/article/viewFile/70/13>

Golinkoff, R. M., & Hirsh-Pasek, K. (2016). Becoming brilliant: What science tells us about raising successful children. <https://www.amazon.com/Becoming-Brilliant-Successful-Children-Lifetools/dp/1433822393>

Govindasamy, P., Abdullah, N., & Ibrahim, R. (2023). The significance and application of creative skills for students with special educational Needs (SEN) with learning disabilities in 21st-century learning. *Journal of Contemporary Social Science and Education Studies (JOCSES)* <https://doi.org/10.5281/zenodo.10174713>

Hu, R., Xiaohui, S., & Shieh, C. J. (2017). A study on the application of creative problem-solving teaching to statistics teaching. *EURASIA: Journal of Mathematics, Science, and Technology Education*, 13(7), 3139-3149. <https://doi.org/10.12973/eurasia.2017.00708a>

Kaplan, D. E. (2019). Creativity in education: Teaching for creativity development. *Psychology*, 10, 140-147. <https://doi.org/10.4236/psych.2019.102012>

Khalid, M. (2017). Fostering problem-solving and performance assessment among Malaysian mathematics teachers. *Sains Humanika*, 9(1-2), 51-55. <https://doi.org/10.11113/sh.v9n1-2.1098>

Khalid, M., Saad, S., Abdul Hamid, S. R., Abdullah, M. B., Ibrahim, H., & Shahrill, M. (2020) Enhancing creativity and problem-solving skills through creative problem-solving in teaching mathematics. *Creativity Studies*, 13(3). 270-291 <https://doi.org/10.3846/cs.202011027>

Kosasih, A., Supriyadi, T., Firmansyah, M. I., & Rahminawati, N. (2022). Higher-order thinking skills in primary school. *Journal of Ethnic and Cultural Studies*, 9(1), 56-76. <http://doi.org/10.29333/ejecs/994>

Lasky, D., & Yoon, S. (2020). A creative classroom for everyone: An introduction to a small 'c' creativity. <https://doi.org/10.1016/j.tsc.2020.100660>

- Maqoqa, T., & Buka, M. A. (2025). Supporting students with special learning needs in mathematics teaching and learning: A case study of five secondary schools in the QR Tambo Coastal District, Eastern Cape, South Africa. *Journal of Education and Learning Technology (JELT)*, 6(3) 87-101. <https://doi.org/10.38159/jelt.2025632>
- Naidoo, J., & Kapofu, W. (2020). Exploring female learners' perceptions of learning geometry in mathematics. *South African Journal of Education*, 40(1), 1-11. <https://hdl.handle.net/10520/EJC-1c03576684>
- Narayanan, S. (2017). A study on the relationship between creativity and innovation in teaching and learning methods towards students' academic performance at private higher education Institution, Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 7(4), 1-10. <https://doi.org/10.6007/IJARBS/v7-i14/3647>
- Norfarahi, Z., Mohd Isa, H., & Khadijah, A. R. (2020). Creativity driving factors among polytechnic students. *Asian People Journal*, 3(2), 77-85. <https://doi.org/10.37231/apj.2020.3.2.210>
- Robinson, (2017). *Out of our minds: The power of being creative*, Oxford, UK: Capstone. <https://www.amazon.com/Out-Our-Minds-Power-Creative/dp/085708741X>
- Saied, B. (2016) Creativity in unique problem-solving in mathematics and its influence on motivation for learning, *Cogent Education*, 3(1), 1202604, <https://doi.org/10.1080/2331186X.2016.1202604>
- Šemberger, T., & Konrad, S.C. (2022). Preschool teacher's beliefs about creativity and children creativeness. *Journal for the Education of Gifted Young Scientists*, 10(1), 37-46. <https://doi.org/10.17478/jegys.1053261>
- Vygotsky, L. S. (1978). *Mind in Society: Development of Higher Psychological Processes*, 86. <https://doi.org/10.2307/j.ctvjf9vz4>
- Zaremohzzabieh, Z., Ahrari, S., Abdullah, R., & Moosivand, M. (2025). Effects of educational technology intervention on creative thinking in education settings: A meta-analysis. *Interactive Technology and Smart Education*, 22, 235-265 <https://doi.org/10.1108/ITSE-11-2023-0224>
- Zhao, S., & Abdullah, A. H. (2025). Enhancing undergraduates' creative thinking through mathematics courses: A systematic literature review. *International Journal of Instruction*, 18(4), 39-56. <https://doi.org/10.29333/iji.2025.1843a>
- Zhou, K. (2018). What cognitive neuroscience tells us about creativity education: A literature review. *Global Education Review*, 5(1), 20-34. <https://files.eric.ed.gov/fulltext/EJ1177633.pdf>

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