The Role of Creative Thinking Models in Statistics Courses for Elementary School Teacher Education Students at Esa Unggul University

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Abstract

This study aims to examine the role of creative thinking models in Statistics courses for students of the Elementary School Teacher Education (PGSD) Study Program at Esa Unggul University. Creative thinking is an important competency that helps students understand statistical concepts procedurally and conceptually. This study used a qualitative approach with data collection techniques through observation, interviews, and documentation. The results showed that creative thinking models increased student engagement, concept exploration, and the ability to develop diverse problem-solving strategies. Consistent implementation of creative thinking models is recommended to support students' higher-order thinking skills.

Keywords: Creative Thinking; Students; Statistics

Introduction

Creative thinking is a crucial competency for prospective elementary school teachers, particularly PGSD students, who are expected to master basic mathematics and statistics concepts. Statistics is often considered challenging by students because it demands conceptual and procedural understanding. Traditional learning approaches tend to focus on formulas and calculations, making it difficult for students to relate concepts to real-world contexts (Hulu et al., 2024). To address this, a creative thinking model was introduced as a learning approach that encourages students to think divergently, generate various problem-solving strategies, and connect statistical concepts to everyday life. This study examines how the creative thinking model plays a role in improving student understanding and engagement in Statistics courses at Esa Unggul University. The importance of this research lies in the role of PGSD students as prospective teachers who will teach mathematics and statistics concepts to elementary school students. Their ability to practice creative thinking will impact the quality of their future teaching.

Creative Thinking in Education

Creative thinking is the ability to generate new, original, and useful ideas. In education, creative thinking enables students to explore multiple perspectives, question assumptions, and develop innovative strategies. (Mardhiyah & Sholehuddin, 2024) describes four components of creative thinking: fluency, flexibility, elaboration, and originality. In an educational context, creative thinking is not only the ability to generate new ideas, but also the ability to view a problem from multiple perspectives and find valuable solutions. Modern education requires students to possess higher-order thinking skills (HOTS).

Creative thinking is a core component of HOTS, making its integration into learning a necessity, not an option. One of the skills required of students is creative thinking. Creative thinking is classified as a higher-order thinking skill (HOTS). With creative thinking skills, students can generate a wide variety of ideas and solutions to problems. Creative thinking is an important skill for today's students in learning mathematics (Nurhayati, 2024). However, many students' creative thinking skills are not honed in mathematics lessons. This results in low students' creative thinking abilities, as evidenced by research conducted by(Fadlilah & Siswono, 2022). Given these facts, efforts are needed to facilitate and cultivate students' creative thinking potential.

Lack of variety or monotonous learning is a major educational problem in schools. Monotonous learning is synonymous with conventional teaching, where teachers only deliver lessons in the same way. This impacts student learning outcomes, interest in learning, and creativity. Based on this learning problem, it appears that not all teachers possess knowledge of diverse learning models or strategies. This is supported by research showing that one of the barriers teachers face in preparing and implementing appropriate learning methods is their limited understanding or insight into learning models or methods. Considering the importance of creating relevant and meaningful learning for students, it also applies to developing student creativity, in line with current educational

needs, and coupled with the aforementioned findings, research related to effective learning models for developing student creativity is crucial (Faisal, 2024). Thus, this research aims to provide an overview of various learning models that can be implemented by teachers or educators in an effort to develop students' creativity in learning.

Creative Thinking Model

Creative thinking models can be integrated through problem-based learning, inquiry-based learning, and brainstorming techniques. In statistics learning, this model emphasizes concept exploration, data interpretation, and the ability to creatively analyze problems. Saleh argues that creative thinking skills play a crucial role in life because creativity is a reliable source of human resources that drives human progress through exploration, development, and new discoveries in science and technology, as well as in all areas of human endeavor. Creative thinking skills are necessary for human development and solving problems faced in everyday life (Hifyatin et al., 2022). Without creative thinking skills, a person will not find answers to their problems, and thus, progress in life is likely to be impossible. Creative thinking skills can enhance understanding and sharpen the parts of the brain associated with pure cognition. When creative thinking skills develop, they generate ideas, discover interconnected relationships, create and use imagination, and gain multiple perspectives on a subject.

Students with high creative thinking skills tend to feel challenged and interested in solving various problems in their learning. This interest in problem-solving also fosters curiosity. Through curiosity, learning is not simply about knowing but also about exploring to learn more, thereby giving meaning to what is learned in the learning process. Curiosity is the foundation for understanding the extent of one's abilities (Telaumbanua, 2022). Curiosity can also stimulate and encourage students to be interested in and participate in learning activities that build knowledge and develop skills. In learning, curiosity is essential for understanding the relationship between previously learned and currently learned concepts, thus creating new concepts. This aligns with Stones's opinion, which states that curiosity can be a driving force, spurring someone to explore knowledge from their environment.

Statistics Learning in the Elementary School Teacher Education Program

Statistics is a compulsory subject in the Elementary School Teacher Education (PGSD) curriculum. This course is designed to equip students with the ability to understand, process, and interpret data accurately. This is highly relevant to the demands of modern elementary education, where teachers are expected to present data-based information, read graphs, understand trends, and engage students in simple data processing activities. As prospective educators, PGSD students must possess adequate numerical literacy to effectively teach basic statistical concepts to elementary school students. In practice, statistics is often considered a challenging subject for prospective teachers. Many PGSD students experience math anxiety, a feeling of fear, tension, or lack of confidence when dealing with numbers and calculations (A. S. Manurung & Pappachan, 2025). This anxiety causes students to be less active, reluctant to ask questions, and difficult to understand important concepts such as mean, median, mode, bar charts, and data interpretation. This can impact their ability to teach statistics to elementary school students less than optimally.

Lack of confidence in learning statistics is often caused by previous learning experiences that emphasize memorization of formulas and mechanical procedures. Students tend to memorize steps without understanding the meaning behind the calculations. Furthermore, a teacher-centered learning approach leaves students passive and deprived of the opportunity to explore concepts through hands-on experience. Effective statistics learning, however, must involve higher-order thinking processes, data analysis, and a deep understanding of concepts (Habbah & Husna, 2024). To address these issues, integrating creative thinking models is an effective solution. Creative thinking models provide space for students to think divergently, generate alternative solutions, and connect abstract statistical concepts to real-world contexts. By involving students in the process of exploring ideas, they can understand that statistics is not just about numbers and formulas, but also about interpreting information, making decisions, and understanding everyday phenomena through data.

The application of creative thinking models in statistics learning can be achieved through various strategies, such as problem-based learning, data processing projects, brainstorming activities, and the use of interactive visual media. For example, students can be asked to collect data from their surroundings, create simple graphs, and then interpret their findings. Activities like these allow students to see the relevance of statistics in their lives while reducing their fear of mathematical calculations. Furthermore, creative thinking encourages students to view statistics as

a fun analytical process. When students are given the freedom to try various strategies and receive feedback without pressure, math anxiety can be significantly reduced (Ripandi, 2023). They become more confident in dealing with statistical concepts and are better prepared to teach them in elementary school. This is important because teachers who understand and are confident in teaching statistics will be able to create engaging and easily understood lessons for students.

Therefore, statistics, as a compulsory subject, plays a strategic role in developing the pedagogical and cognitive competencies of elementary school teacher education students. The integration of creative thinking models not only helps improve students' conceptual understanding but also fosters positive attitudes toward learning statistics. Ultimately, creative and confident prospective teachers will be able to foster data literacy from an early age in elementary school students, a crucial skill in today's information age.

The Relevance of Creative Thinking to Statistical Problem Solving

Problem solving is at the core of statistics learning, both at the elementary school and university levels. In statistics, problem solving is not only related to performing numerical calculations, but also includes the ability to identify patterns, understand the context of data, interpret information, and draw logical conclusions based on evidence. These abilities are essentially a concrete manifestation of the creative thinking process (Hifyatin et al., 2022). Therefore, creativity is a crucial component in statistics learning for prospective teachers, including elementary school teacher education students. Problem solving in statistics begins with the ability to identify patterns. Patterns appear in various forms, such as data trends, relationships between variables, value distributions, or group comparisons. The ability to see patterns does not always emerge automatically; it often requires visual exploration, repeated observation, and flexible thinking skills. Creative students are usually able to see patterns in different ways, for example, discovering relationships that are not immediately apparent or interpreting anomalies as part of data understanding, rather than simply calculation errors.

Once a pattern is identified, the next step is to interpret the data. Data interpretation is a process that involves reflective, analytical, and creative thinking simultaneously. Students must understand the meaning behind numbers what the mean, median, or mode mean in a given context, how data variation impacts the understanding of a phenomenon, and how graphs convey a broader message. This interpretation process requires the ability to connect data to reality, find meaning in information, and construct a logical narrative (Faisal, 2024). This is where creativity comes into play: students must be able to generate plausible explanations while remaining open to multiple interpretations. The next step in statistical problem-solving is evaluating alternative solutions. In statistics, there is rarely a single, absolute correct answer. Instead, many problems can be solved through multiple approaches, such as graphical methods, descriptive analysis, or specific calculations.

Students who think creatively are able to consider several possible solutions and then choose the most effective, efficient, and contextually appropriate approach. This ability reflects the flexibility and elaboration aspects proposed by Torrance. Furthermore, creative thinking helps students view statistical problem-solving as a process, not just a result. They learn that calculations are part of the overall thinking process, not the end goal (Fadlilah & Siswono, 2022). Thus, students are able to develop systematic strategies while remaining open to new discoveries. This is crucial for prospective teachers, as they must teach elementary school students that statistics is not just about "calculating," but rather about understanding information and making data-based decisions.

Integrating creative thinking into statistical problem-solving can also reduce the math anxiety often experienced by elementary school teacher education students. When students are given the space to try various methods, explore, and discuss without fear of error, they become more confident and motivated. Learning models that encourage creativity, such as project-based learning, case studies, or investigative activities, help students understand that mistakes are part of the thinking process, not something to be avoided (Nurhayati, 2024). Thus, creative thinking plays a fundamental role in statistical problem-solving. The ability to identify patterns, interpret data, and evaluate alternative solutions not only enhances students' conceptual understanding but also prepares them to become teachers capable of teaching statistics in an engaging, meaningful, and contextual way to elementary school students. Creativity transforms statistics from a daunting subject to a tool for understanding the world through data.

Method

This research uses a qualitative approach because it aims to explore in-depth the role of creative thinking models in the learning process of Statistics courses. A qualitative approach was chosen based on the consideration that the phenomena studied relate to the experiences, perceptions, interactions, and learning processes of Elementary School Teacher Education (PGSD) students, which cannot be measured numerically. Through this approach, researchers can understand how students respond to creative thinking models, how classroom dynamics occur, and how the application of creative strategies can enhance their engagement and understanding of statistics material.

The research subjects were Elementary School Teacher Education (PGSD) students from Esa Unggul University, taking Statistics courses in the academic year of 2025. Subject selection was purposive, based on the consideration that this group of students was directly involved in the process of implementing the creative thinking models that were the focus of the study. They were deemed capable of providing relevant data regarding the impact of these models on their learning experiences. PGSD students are prospective elementary school teachers, so their understanding of statistics and creative thinking models has long-term implications for the quality of learning in elementary schools. In qualitative research, data collection techniques must be able to capture phenomena in their entirety and naturally. Therefore, this study utilized three main techniques: observation, interviews, and documentation (Rizky Fadilla & Ayu Wulandari, 2023).

Observation

Observations were conducted to directly observe how the learning process took place, how lecturers applied the creative thinking model, and how students participated in learning activities. Observation techniques allowed researchers to observe students' actual behavior—for example, their engagement in discussions, their ability to express ideas, or how they solved statistical problems using creative approaches. Through observation, researchers were also able to identify classroom atmospheres, interactions between students, and spontaneous responses that might not have emerged in interviews. Observations were conducted as moderate participants, meaning the researcher was present in class but not directly involved in the learning process. This maintained objectivity while still allowing for contextual understanding.

Interviews

Interviews were conducted to explore students' experiences, perceptions, and understanding regarding the application of the creative thinking model. The interviews were semi-structured, providing researchers with guided questions but still allowing students to freely share their experiences. Through interviews, researchers were able to understand how students assessed the effectiveness of the creative thinking model, how they perceived changes in their understanding of statistical material, and what challenges they faced. Interviews also provided in-depth data on emotional aspects, such as math anxiety or increased confidence in completing statistical assignments.

Documentation

Documentation is used to obtain written and visual data. Documents collected include teaching materials, student assignments, reflection notes, worksheets, and other learning products. Documentation data helps strengthen observation and interview results because it provides concrete evidence of the development of students' creative thinking skills. For example, analysis of student assignments can demonstrate how they identify data patterns, develop problem-solving strategies, or generate creative interpretations. Documentation also allows researchers to trace the learning process over time, providing a clearer picture of the development that occurs.

These three data collection techniques complement each other in producing credible and comprehensive data. Observations provide a direct view of the learning process, interviews provide in-depth information about students' personal experiences, while documentation provides physical evidence that strengthens the research findings. By using a systematic qualitative approach and diverse data collection techniques, this study was able to provide a comprehensive understanding of how creative thinking models play a role in improving statistical understanding in PGSD students.

Data Analysis

The data analysis model developed by Miles and Huberman is one of the most widely used approaches in qualitative research. This model provides a systematic and structured framework for managing qualitative data, which is often complex, diverse, and rich in meaning. According to Miles & Huberman (1994), qualitative data analysis consists of three main, simultaneous and interrelated

activities: data reduction, data display, and conclusion drawing/verification. These three components form a continuous analytical process that helps researchers understand the phenomena being studied in depth and meaningfully.

Data Reduction

Data reduction is the process of simplifying, selecting, focusing, abstracting, and organizing raw data into a more meaningful form. In qualitative research, the data obtained is usually extensive, and not all of it is relevant to the research focus. Therefore, researchers must select the data to ensure that only important information is analyzed further. The data reduction process can include activities such as coding, identifying themes, marking patterns, classifying information, or grouping data into specific categories. Data reduction is not only carried out at the end of the research, but also begins from the beginning of data collection and continues iteratively. In the context of research on creative thinking models in statistics learning, data reduction includes selecting information related to students' creative activities, interactions during the learning process, and their responses to the use of the model (Sugandi et al., 2021). Data reduction does not mean eliminating important information, but rather helps researchers focus attention on the most relevant and meaningful aspects to answer the research questions. Thus, the data reduction stage is a crucial foundation for the success of the overall qualitative analysis.

Data Display

Data display is the process of organizing data into an organized form that allows researchers to fully understand the information. Data presentations can take the form of tables, charts, matrices, concept maps, graphs, or structured descriptive narratives. The purpose of data presentation is to facilitate researchers in seeing relationships between components, discovering patterns, and identifying significant findings. According to Miles and Huberman, good data presentation should facilitate researchers' direct interpretation (Mahmudi & Sumarmo, 2015). In research on creative thinking models, data presentation can be done through matrices depicting indicators of student creative thinking (such as fluency, flexibility, originality, elaboration), tables showing student responses in interviews, or concise narratives of student behavior during the observation process. Data presentation not only organizes information but also helps researchers see the overall development of findings. At this stage, researchers begin to make connections between theory, field data, and initial interpretations of the phenomena being studied.

Conclusion Drawing and Verification

According to Miles and Huberman, the final stage in data analysis is conclusion drawing and verification. Conclusions are drawn by interpreting the reduced and presented data to answer the research questions. Conclusions should be based on strong evidence found in the field, not subjective assumptions. The conclusion drawing process is dynamic; initial conclusions can change or evolve as the analysis progresses. Therefore, verification is necessary to ensure that the conclusions reached are truly accountable (Ridwan, 2021). Verification can be done through data triangulation, cross-checking field notes, discussions with fellow researchers, or confirmation from respondents (member checking).

In research on creative thinking models, conclusions drawn include interpretations related to improved student understanding, behavioral changes in learning, and the effectiveness of creative thinking models in the context of Statistics courses. Through verification, researchers can ensure that these conclusions are valid and consistent with empirical data.

Results

The research results demonstrate a positive impact from implementing the creative thinking model: the following analysis shows increased student engagement and a collaborative learning atmosphere.

Improved Student Engagement

Student engagement is one of the main indicators of a successful learning process, especially in the context of higher education. Engagement encompasses not only physical presence but also active participation, attention, motivation, and a sense of responsibility in participating in the learning process. In Statistics courses, student engagement plays a crucial role because the learning material is often considered abstract and requires a strong conceptual understanding. Therefore, increasing student engagement is a crucial focus in implementing the creative thinking model. This increase in student engagement is evident in their increased activity in discussions, asking questions, and working collaboratively in groups.

Discussion is a highly effective form of learning activity for building conceptual understanding. Through discussions, students have the opportunity to express their thoughts, hear other perspectives, and reconstruct their understanding based on feedback from peers and lecturers. When the creative thinking model is implemented, students are encouraged to share new ideas, offer alternative solutions, and relate statistical concepts to real-world situations. This makes discussions more lively, dynamic, and meaningful. In addition to discussion, increased engagement is also reflected in students' courage to ask questions. Asking questions is an indicator of critical and creative thinking. Students who are actively engaged are usually not satisfied with simply passively receiving information but seek to understand the concepts being studied more deeply. Questions can relate to clarifying concepts, applying theory to specific contexts, or finding alternative solutions to statistical problems. In a creative learning environment, students feel safe and valued to ask questions without fear of being wrong or being judged negatively (A. S. Manurung et al., 2022). This indicates that the learning environment supports a sense of curiosity and learning autonomy.

Involvement in group activities is also a positive impact of implementing a creative thinking model. Group-based learning allows students to work together, exchange ideas, and support each other in completing assignments. In groups, students learn to build effective communication, divide tasks proportionally, and solve problems collaboratively. This collaborative ability is crucial for generating deeper understanding, as students can learn from the experiences and perspectives of other group members. Group activities involving creative problem-solving often encourage student participation, as each member has the opportunity to make unique contributions. Increased student engagement is also influenced by changes in learning methods from passive to more active, exploratory, and collaborative. Creative thinking models facilitate students' hands-on learning experiences, rather than simply listening to explanations (A. Manurung et al., 2021). When students engage in creative activities, such as real-life case-based data analysis, mini-projects, or independent graphic exploration, they feel more challenged and motivated to engage more deeply. This automatically increases the time they spend understanding the material, thus improving the quality of learning. In the long term, increased student engagement will impact conceptual understanding, higher-order thinking skills, and confidence in tackling statistics material considered difficult. High engagement also fosters a positive attitude toward learning, so students are better prepared and motivated to apply statistical concepts in professional contexts as prospective elementary school teachers.

Improving Conceptual Understanding

Students are able to understand statistical concepts through real-world contexts, not simply by memorizing formulas. Some habits often demonstrated by creative individuals include: (1) a tendency to actively engage in problem-solving, (2) the ability to think outside the box by combining existing knowledge with new ideas, (3) the ability to set clear standards and criteria, and (4) the courage to challenge existing norms and conventions. Based on research, Munandar stated that to determine someone's creativity, we can look at four things: fluency, flexibility, elaboration, and originality (Mahmudi & Sumarmo, 2015). Fluency refers to the ability to flow ideas without hindrance. Flexibility refers to the flexibility of the mind in generating original ideas and viewing a problem from various angles. Elaboration refers to the process of analyzing, expanding, and developing an idea or concept into greater detail and depth. Originality refers to the ability to express original and distinctive thoughts in the face of various challenges.

Developing Problem-Solving Skills

Students can generate a variety of different strategies when solving statistical problems. According to Polya (1973), problem-solving involves creative thinking skills (in the divergent phase). Students need to understand the solution process and be skilled at selecting, identifying necessary and relevant conditions and concepts, seeking generalizations, formulating a solution plan, and organizing previously acquired skills. According to(Hulu et al., 2024), problem-solving is directed thinking aimed at determining a solution to a specific problem. (Mardhiyah & Sholehuddin, 2024)also define problem-solving as a means for someone to use previously acquired knowledge, skills, and understanding to meet the demands of unusual circumstances. Problem-solving skills are fundamentally necessary for students facing real-life situations (Muhamad 2010). Based on these opinions, it can be concluded that problem-solving is the effort to find a way out or solution to a difficulty, achieving goals that are not immediately achievable. Problem-solving is not just a skill to be taught and used in physics, but also a skill that can be applied to everyday problems or decision-making situations, thus serving a person well throughout their life. Problem-solving provides students with opportunities to make connections with their prior knowledge and make decisions

about the representations, tools, and computational strategies needed to solve problems. To become skilled problem-solvers in physics, students must understand concepts and be able to view physics as a holistic, interconnected whole.

Discussion

The research findings indicate that the creative thinking model significantly contributes to improving student learning processes and outcomes in Statistics courses. By providing open-ended assignments, inquiry-based questions, and real-life cases, students learn to develop flexible and analytical thinking. These findings align with previous studies that suggest that creative thinking influences the development of higher-order thinking skills. In the context of teacher education, these skills are crucial for students to design creative learning strategies when teaching in elementary schools. Challenges identified include limited learning time and students' initial adaptation to new approaches. However, these obstacles can be overcome through ongoing training and structured guidance from lecturers.

Conclusion

This study concludes that the creative thinking model plays a significant role in increasing the engagement, conceptual understanding, and problem-solving abilities of PGSD students in Statistics courses.

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