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The Influence of Mathematical Creative Thinking Ability in Terms of Learning Styles on the Learning of Compound Interest and Annuities among Students

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A B S T R A C T

This study aims to analyse the relationship between students' learning styles (visual, auditory, and kinaesthetic) with mathematical creative thinking skills, and to determine which learning style has the most dominant influence. The research method used is a mixed method, which combines qualitative and quantitative approaches to obtain a more comprehensive understanding. The results of the study indicate that there are variations in students' mathematical creative thinking skills that are influenced by their respective learning styles. Visual, auditory, and kinaesthetic learning styles have been shown to have a significant influence on students' mathematical creative thinking skills. In particular, auditory learning styles have the most dominant influence compared to visual and kinaesthetic learning styles. These findings indicate the importance of understanding students' learning styles to improve their mathematical creative thinking skills. Thus, the results of this study contribute to the development of adaptive learning strategies, in accordance with students' learning styles, in order to support the achievement of optimal learning outcomes.

Keywords: *Visual Learning Style, Auditory Learning Style, Learning Style, Students' Mathematical Creative Thinking Ability*

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INTRODUCTION

The development of creative thinking skills needs to be done because this ability is one of the desired abilities in the world of work (Career Centre Maine Department of Labor USA, 2004). The ability to think creatively is also a determinant of a nation's excellence. The competitive power of a nation is determined by the creativity of its human resources. Therefore, mathematics learning needs to be designed in such a way that it has the potential to develop students' creative thinking skills. According to De Bono as cited by Barak & Doppelt (2000), states that there are 4 levels of development of creative thinking skills, namely thinking awareness, thinking observation, thinking strategies and thinking reflection. Silver (1997) stated that creative thinking indicators consist of fluency, flexibility, and novelty indicators. In line with this, Anwar et al (2012) stated that creative thinking is a new way of seeing things characterized by four components, namely fluency, flexibility, originality, and elaboration. According to Siswono (2007) In creative thinking, a person will go through the stages of synthesizing ideas, building ideas, planning the application of ideas, and implementing these ideas so as to produce something or a new product. The product in question is creativity. This also happens and appears at SMK 1 Dukuh Turi Tegal Regency, the phenomenon that appears to occur at SMK 1 Dukuh Turi Tegal Regency is the tendency

of students who when given a problem tend to only memorize a number of formulas, calculations and problem solving steps that have been explained by the teacher or in the textbook. There is no discovery of new ideas or linking material with the real world by students. In addition, students also show that students' mathematical creative thinking skills are lacking because students are still not accustomed to developing their mathematical creative thinking skills in solving problems, the existence of student errors in learning where students are still patterned with learning styles that rely on memorization and formula application.

According to Brueckner and Bond, Cooney, Davis and Henderson in (Widdiharto, 2008) explain the factors that cause student learning difficulties which are grouped into five, namely physiological factors (physical defects or disorders, fatigue and others), social factors (interaction with family, friends, economics and others), emotional factors (fear, anxiety, hatred, low motivation and others), intellectual factors (learning style, thinking style, IQ, and others), pedagogical factors (facilities, methods, learning media, teachers and others). Among the several factors that influence learning difficulties are how students can learn well so that the information obtained can be maximized and how teachers choose effective learning models. Of the 5 factors, this research focuses on intellectual factors, especially in the aspect of learning style.

DePorter & Hernacki (2007: 112) state that everyone has one or a combination of three types of learning styles, namely visual, auditoria and kinaesthetic learning styles. By knowing the learning style of each student, teachers will more easily determine the strategies, methods, approaches that will be used to help students learn optimally. However, if it is not appropriate in choosing a learning strategy, then students will have difficulty in learning. With an initial understanding of learning styles, students who have learning difficulties will get more attention, so that difficulties in learning can be minimized and the quality of learning can be improved. One of the learning model innovations that can be used is to use the Treffinger learning model. Learning mathematics using Treffinger's creative learning model is considered to be able to improve students' creative thinking skills because it trains students to express their ideas creatively which in turn students will be able to find the most effective way to solve a problem. In addition, this model also involves affective aspects in problem solving which makes students able to understand the situation and conditions of a problem. In a study conducted by Pomalato (2006), it was proven that Treffinger model learning in mathematics learning provides a positive contribution to increasing students' mathematical creativity in learning mathematics.

The relevance of learning styles in learning mathematics is also supported by recent research. Firdausi (2018) mentioned that mistakes in choosing learning strategies can lead to low students' creative thinking skills. Munandar (2012) emphasized that intelligence, motivation, and learning styles greatly influence creativity in learning. Purwanti (2019) and Tanamir et al. (2020) stated that each student has a dominant learning style that can be optimized to maximize learning outcomes. In addition, the use of learning models such as Treffinger has been proven effective in improving students' creative thinking skills (Pomalato, 2006). This model trains students to express creative ideas and solve problems innovatively by involving affective aspects, so that students are able to understand the conditions of the problem in depth.

In learning mathematics, it is important to apply strategies that support students' learning styles. Ghufron and Risnawati (2014) explain that learning style is the way individuals absorb, process, and understand information. Porter and Hernacki (2003) state that learning that is tailored to students' learning styles will facilitate the learning process and improve the results achieved. Visual, auditory, and kinesthetic learning styles, as described by DePorter & Hernacki (2015), must be recognized and applied effectively in mathematics learning to support the development of students' mathematical creative thinking skills.

Purwanti (2019: 92) explains that students' creativity in solving mathematical problems can be influenced by the learning style factors that students themselves have, whether visual, auditory, or kinesthetic learning styles. Each learner has one learning style that is dominant in him. Tanamir, et al (2020: 53) state that each individual has all three learning styles. However, there is usually one learning style that is more dominant.

Ghufron and Risnawati (2014: 42) state that learning style is an approach that explains the way each person concentrates on the process, mastering difficult and new information through different perceptions. Porter and Hernacki (2003: 112) explain that learning style is a combination of the way a person absorbs, organizes, and processes information. Basically, to achieve the best results in learning targets, everyone has a different learning style. Learning can be easily done if a person finds a learning style that matches his personality.

Learning styles are divided into 3 types, namely visual learning styles, auditorial learning styles, and kinaesthetic learning styles. Visual learning style is a way of learning through the sense of sight. Auditory learning style is a way of learning through the sense of hearing. Kinaesthetic learning style is a way of learning through movement and touch (Deporter, B. & Hernacki M., 2015: 112).

METHOD

Mixed Methods research is an approach that integrates both qualitative and quantitative research techniques in a single study to gain a more holistic understanding of a phenomenon. This approach is often referred to as combination research, as it involves the use of both qualitative and quantitative data, offering a broader scope of analysis. As stated by Creswell (2009) and Sugiyono (2013), Mixed Methods research connects these two research forms, allowing for a deeper and more comprehensive exploration of the research topic. Similarly, Johnson et al. (2007) highlighted that combining qualitative and quantitative elements enables researchers to achieve both breadth and depth in their understanding and corroboration of findings.

The research population in this study consists of 571 students from Class XI at SMK 1 Dukuh Turi, Tegal Regency, across 16 classes and six different departments. These departments include Office Management, Computer Network Engineering, Accounting, Software and Games Development, Marketing, and Visual Communication Design. A sample of 230 students was selected using proportional and random sampling techniques, as guided by Krejcie's table (Sugiyono, 2005), ensuring an accurate representation of the population. Proportional sampling ensures that the learning styles (visual, auditory, kinesthetic) from each department are adequately represented, while simple random sampling further ensures randomness within the population.

Quantitative data collection is performed using questionnaires with Likert-scale questions to assess various factors, such as students' mathematical critical thinking skills and learning styles. Additionally, tests or exams are used to gather data on students' academic achievements, and existing student records are referenced to gain insight into their overall performance. These quantitative methods are used to quantify the research variables, providing numerical data for further analysis. The Likert-scale questionnaire offers a structured way to gather responses, while the use of existing student exam data adds a layer of historical context to the research.

Qualitative data collection techniques involve interviews, observations, and document studies, which complement the quantitative data by offering in-depth insights into the students' experiences and behaviors. This combination of data collection methods allows researchers to view the research topic from multiple perspectives, ensuring a richer understanding of the subject matter. Qualitative techniques provide the flexibility to explore

unquantifiable aspects of the study, such as student perceptions, attitudes, and motivations, adding depth to the findings that go beyond mere numbers.

Data analysis for Mixed Methods research involves both quantitative and qualitative techniques. Quantitative data can be analyzed using descriptive statistics and hypothesis testing, such as ANOVA, to determine relationships and differences between variables. On the other hand, qualitative data analysis involves techniques like thematic analysis, which identifies key themes or patterns in the data, and narrative analysis, which explores the stories or events shared by participants. Combining these two types of analysis allows researchers to triangulate findings and strengthen the validity and reliability of their conclusions.

FINDINGS AND DISCUSSION

In this study the proposed hypothesis is accepted There is a relationship between visual, auditoria, and kinaesthetic learning styles on mathematical creative thinking skills, although the level and type of relationship varies. This tendency occurs in vocational students where the sample of this study is adolescence. Adolescence is an important period in individual development, including in terms of learning. Adolescents experience cognitive, emotional and social changes that affect how they learn. Understanding the characteristics of adolescents in learning, especially their learning styles, is very important for parents, teachers and educators to support their success. There are several Characteristics of Adolescents in Learning, namely Cognitive Development where adolescents experience the development of abstract, logical and critical thinking skills. They begin to be able to think about possibilities, hypotheses, and complex concepts.

During adolescence there is an Identity Search where adolescents are in the process of searching for their identity. This affects their interest and motivation to learn. They tend to be more interested in things that are relevant to themselves and their future.

In addition, adolescence is influenced by peers. Peers have a strong influence on adolescents. They often study and interact with their friends, and the opinions of peers can influence their attitudes towards learning so there are Emotional Changes. Teenagers experience significant emotional changes. They may experience stress, anxiety or boredom which can affect their concentration and motivation to learn. Finally, they are independence, where adolescents tend to want to be more independent and have control over their learning. They want to be involved in making decisions about what and how they learn.

Teens with a visual learning style find it easier to understand and remember information through pictures, diagrams, graphs, videos and other visual representations. They tend to prefer reading, viewing and observing. Adolescents with an auditory learning style find it easier to understand and remember information through hearing, such as oral explanations, discussions, lectures and sound recordings. They tend to prefer listening and talking. Teenagers with a kinaesthetic learning style find it easier to understand and remember information through movement, touch and hands-on experience. They tend to prefer doing, practicing and physically interacting with learning materials.

The results of the research in this study explain that students at SMK N 1 Dukuhturi Tegal Regency show that students at SMK N 1 Dukuhturi Regency tend to learn with an auditorial learning style this is because students more easily understand and remember information through hearing, such as oral explanations, discussions, lectures, and sound recordings. Students tend to prefer listening and talking. Learning activities like this can be done with Coopertaive Learning or group learning. Group learning is very important for students, especially for those with auditory learning styles, for the following reasons:

Improved Comprehension through Oral Discussion

Students with auditory learning styles find it easier to understand material through conversation and discussion. In group learning, students can talk about the topic being

studied, listen to explanations from friends, and ask questions. This process helps strengthen their understanding as they remember information better through listening and speaking.

Verbal Interaction for Reinforcement

Listening to the material being explained by a peer can help auditory students absorb information more effectively. When a groupmate verbalizes an explanation or example, it provides an opportunity to listen to different ways of explanation that may be easier to understand than the way they learned on their own.

Repetition Through Discussion

In group learning, material will often be discussed and repeated. This repetition process is very beneficial for auditory students, as they tend to remember information heard many times. Listening to the different points of view of the group also helps to strengthen their memory of the topic.

Improves Communication Skills

Students with auditory learning styles usually excel at speaking and listening. Group learning gives them the opportunity to hone their communication skills, both in speaking clearly and in listening carefully. This is very beneficial for their academic and social development.

Encourages More Active Learning

Group learning creates a more active and dynamic environment. Auditory students can be directly involved in conversations and discussions, which makes the learning process feel more alive. This is in contrast to learning that relies solely on reading materials or notes which may be less interesting to them.

Increases Self-Confidence

In group learning, auditory students can be more confident as they can express their opinions by listening to their peers' responses. This helps them feel more confident in their understanding of the material discussed. Overall, group learning provides a rich experience for auditory students, who prioritize listening and speaking in their learning.

There is a level of mathematical creative thinking ability of grade 2 students of SMK N 1 Dukuhturi in compound interest and annuity learning in the 2024/2025 school year in the low to medium to high category, with variations influenced by each student's learning style.

There is a significant influence between visual students' learning style on mathematical creative thinking ability in compound interest and annuity learning in class 2 of SMK N 1 Dukuhturi in the 2024/2025 academic year. From the ANOVA analysis with SPSS calculations, it can be seen that the significance value of visual students' learning style on students' mathematical creative thinking ability is 0.83 which means ≥ 0.050 (0.83≥0.050). This means that the visual learning style has similarities in students' ability to think creatively, and from the significance probability value, F is obtained at 3.073 with a significance probability value of 0.83 ≥ 0.050, which means that the hypothesis is accepted, namely that there is a significant influence between visual student learning styles on the ability to think creatively mathematically in compound interest and annuity learning in class 2 of SMK N 1 Dukuhturi in the 2024/2025 school year.

There is a significant positive influence between the learning style of auditorial students on the ability to think creatively mathematically in understanding the concept of compound interest and annuity in class 2 of SMK N 1 Dukuhturi in the 2024/2025 academic year. From the ANOVA analysis with SPSS calculation, the significance value of auditory students' learning style on students' mathematical creative thinking ability is 0.14 which means ≥ 0.050 (0.14≥0.050). This means that the auditory learning style has similarities in students' ability to think creatively, and from the significance probability value, F is obtained at 6.334 with a significance probability value of 0.14 ≥ 0.050, which means that the hypothesis is accepted, namely that there is a significant influence between the auditory student learning style on

the ability to think creatively mathematically in compound interest and annuity learning in class 2 of SMK N 1 Dukuhturi in the 2024/2025 school year.

There is a significant influence between kinesthetic student learning styles on mathematical creative thinking skills in compound interest and annuity learning in class 2 of SMK N 1 Dukuhturi in the 2024/2025 school year. From the ANOVA analysis with SPSS calculations, it can be obtained that the significance value of kinesthetic student learning styles on students' mathematical creative thinking skills is 0.127 which means ≥ 0.050 (0.127≥0.050). This means that the kinesthetic learning style has similarities in students' ability to think critically, and from the significance probability value, it is obtained F of 2, 439 with a significance probability value of 0.127 ≥ 0.050, which means that the hypothesis is accepted, namely that there is a significant influence between the learning style of kinesthetic students on the ability to think creatively mathematically in learning compound interest and annuity in class 2 of SMK N 1 Dukuhturi in the 2024/2025 school year.

There is a significant difference in influence between visual, auditory, and kinesthetic learning styles on students' mathematical creative thinking skills in compound interest and annuity learning in class 2 of SMK N 1 Dukuhturi in the 2024/2025 school year, with one learning style showing a more dominant influence. From the summary of the calculation of ANOVA analysis with SPSS calculations consisting of Mean and ANOVA analysis, the significance value of student learning styles (Visual. Auditory, kinesthetic) on students' mathematical creative thinking ability is 0.476 which means ≥ 0.050 (0.476≥0.050). This means that visual, auditorial, and kinesthetic learning styles have similarities in students' ability to think creatively, and from the significance probability value, F is obtained at 4.439 with a significance probability value of 0.476 ≥ 0.050, which means that the hypothesis is accepted, namely that there is a significant influence between visual, auditorial, and kinesthetic student learning styles on the ability to think creatively mathematically in compound interest and annuity learning in class 2 of SMK N 1. Dukuhturi school year 2024/2025. When viewed from learning styles that show a more dominant influence on critical thinking, auditory learning styles are more dominant in their influence on critical thinking compared to visual learning styles and kinesthetic learning styles. This can be seen from the Mean Square results of students' learning styles, thus in this study at SMK N 1 Dukuhturi Tegal Regency shows that students at SMK N 1 Dukuhturi Tegal Regency tend to learn with an auditorial learning style, this is because students more easily understand and remember information through hearing, such as oral explanations, discussions, lectures, and sound recordings. Students tend to prefer listening and talking.

CONCLUSIONS

The study on the mathematical creative thinking abilities of grade 2 students at SMK N 1 Dukuhturi in the 2024/2025 academic year reveals significant influences of various learning styles (visual, auditory, and kinaesthetic) on students' critical thinking in compound interest and annuity learning. ANOVA analysis with SPSS indicates that all three learning styles have a similar impact on students' mathematical creative thinking, with significance values for visual (0.83), auditory (0.14), and kinaesthetic (0.127) all being greater than the 0.050 threshold. The results suggest that auditory learning styles, which emphasize learning through listening, have the most dominant effect on students' creative thinking abilities. Students who prefer auditory learning, such as listening to oral explanations and participating in discussions, tend to perform better in critical thinking tasks related to compound interest and annuity. These findings imply that teaching strategies should incorporate auditory elements to enhance students' mathematical creative thinking, as auditory learners tend to grasp and retain information more effectively through auditory means.

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