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Creative Thinking Ability of High School Students in Solving Physics Questions Based on Local Wisdom

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ABSTRAK

Penelitian ini merupakan penelitian deskriptif kuantitatif bertujuan untuk mengetahui gambaran kemampuan berpikir kreatif peserta didik SMA dalam menyelesaikan soal fisika berbasis kearifan lokal. Data yang diperoleh dalam penelitian ini berupa data kuantitatif yang dianalisis menggunakan statistik deskriptif. Sampel dalam penelitian ini berjumlah 45 peserta didik. Berdasarkan uji Gregory nilai validitas yang diperoleh sebesar 1. Berdasarkan syarat uji Gregory jika $V_c \geq 0{,}75$ atau ≥ 75 % maka dapat disimpulkan bahwa semua butir soal kemampuan berpikir kreatif layak untuk digunakan. Uji reliabelitas yang diperoleh adalah 0,83 dan dinyatakan reliabel. Instrumen yang digunakan untuk mengumpulkan data berupa tes essai berjumlah 12 butir soal yang dikembangkan sesuai dengan indikator kemampuan berpikir kreatif yang meliputi indikator berpikir lancar, berpikir luwes, berpikir original, dan berpikir elaborasi. Berdasarkan data hasil penelitian, diperoleh bahwa kemampuan berpikir kreatif dalam menyelesaikan soal fisika berbasis kearifan lokal berada pada kategori rendah. Berdasarkan hasil wawancara, menunjukkan bahwa 42% peserta didik tidak mampu untuk menjelaskan keterkaitan konsep fisika pada soal yang diberikan. Hal ini dapat disimpulkan bahwa gambaran kemampuan berpikir kreatif peserta didik SMA dalam menyelesaikan soal fisika berbasis kearifan lokal berada pada kategori rendah.

ABSTRACT

This quantitative descriptive study aims to describe high school students' creative thinking abilities in solving physics problems based on local wisdom. The data obtained in this research is quantitative and analyzed using descriptive statistics. The sample in this research consisted of 45 students. Based on the Gregory test, the validity value obtained is 1. Based on the Gregory test requirements, if $V_c \geq 0.75$ or ≥ 75%, it can be concluded that all items on creative thinking abilities are suitable for use. The reliability test obtained was 0.83 and was declared reliable. The instrument to collect data was an essay test consisting of 12 questions developed by indicators of creative thinking ability, including indicators of fluent thinking, flexible thinking, original thinking, and elaborative thinking. Based on research data, it was found that the ability to think creatively in solving physics problems based on local wisdom was in the low category. Based on the results of interviews show that 42% of students were unable to explain the relationship between physics concepts in the questions given. It can be concluded that the description of high school students' creative thinking abilities in solving physics problems based on local wisdom is in the low category.

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INTRODUCTION

According to the legislation mentioned in Law No. 20 of 2003, education is directed towards conscious and planned efforts to create a learning environment that supports the development of students' potential. The focus is on strengthening spiritual dimensions, developing self-control, forming positive personalities, enhancing intelligence, instilling good moral values, and providing relevant skills for individuals and society by the demands of existence in the context of the nation and state (Depdiknas, 2003).

The most critical factor that influences the quality of human life is education. Education is the only way to transform a person into a morally upright, intelligent, and self-sacrificing individual. The most critical component in the field of education is the curriculum. The curriculum is viewed as an effective educational program in teaching and all other aspects of learning. It must align with educational goals to improve student's quality of life inside and outside the classroom.

Therefore, the Government carries out its duty by developing the 2013 curriculum that aligns with the 21st century. In developing the 2013 curriculum can be implemented through physics subjects. Physics learning is fundamentally divided and defined as a product, process, and attitude formation. The knowledge gained will be realized through facts, concepts, principles, laws, equations, and theories from each model. Physics concepts are concepts born based on concepts that tend to be abstract, so it is essential for educators to teach them creatively and innovatively (Mulder & Siswanto, 2023).

In the context of physics education, students are expected to have critical analytical thinking skills, be creative, and collaborate well with others. The mentioned physics education is related to 21st-century education. With the addition of such roles, the six 21st-century skills, one of which is creativity, are then known as the 6Cs.

Creative thinking ability is considered necessary in the learning objectives of physics in the 2013 Curriculum. These objectives include understanding physics concepts and principles and developing skills to enhance students' knowledge and confidence to pursue higher education and contribute to the development of science and technology (Kemendikbud, 2014). According to this vision of learning, physics teaching must provide opportunities for students to maintain their understanding of physics concepts, principles, and norms.

Research (Asriadi & Istiyono, 2020) shows that creative thinking skills involve generating new ideas and using existing ideas creatively to solve problems from various perspectives. Physics subjects are an integral part of natural sciences that cover knowledge about matter, energy, and their changes. The essence of physics learning is students' awareness of understanding concepts and interrelationships through exploration and experiments and their ability to apply this knowledge in solving everyday problems. Effective physics learning will result in meaningful and relevant understanding for each student, enriching their learning experiences. Therefore, educators need to encourage and develop students' creative thinking abilities. This skill is crucial in physics learning because it helps enhance abstract thinking abilities and solve physics problems more effectively.

According to Utami Munandar (1995), Creative thinking is a general ability to create something new, generate new ideas that can be applied in problem-solving, or see new relationships between previously existing elements. Building creative thinking ability is a necessity. The belief is that creative thinking is a specific exploratory strategy for generating new ideas that differ from existing ones. Therefore, to successfully implement specific skills in classroom lessons, it is essential to engage students actively. However, this situation is not always addressed because education often focuses more on developing and testing students' memory power and is consistently viewed as a memorization skill.

Students are given tasks to solve physics problems in learning. Physics problem exercises are provided so they can master solving problems in the same context. However, some students are still not fully proficient in solving problems related to physics theory. When students can solve physics problems, they generally rely on material from books or what their teachers give them their teachers give them. However, when the problems are revised, some students are reluctant to continue or study them further because they find it difficult.

Students' creative thinking processes can be identified using the framework introduced by Wallas (as cited by Munandar, 2002). This framework is one of the most commonly used models for understanding

the creative thinking process in the context of discovery and the arts. Wallas proposed that the creative process consists of four main stages: 1) Preparation, 2) Incubation, 3) Illumination, and 4) Verification. In the initial stage, individuals prepare themselves by gathering relevant information and seeking approaches to solve the problem. In the next stage, individuals let their minds rest for a while from the problem, often leading to the emergence of creative ideas from the subconscious. The third stage involves the emergence of innovative problem-solving, preceded by generating new ideas. Finally, the verification stage involves testing and evaluating the generated problem-solving to ensure its relevance to reality.

Munandar (2009) outlined four indicators of creative thinking ability as follows:

1. Fluent thinking: Generating ideas continuously, providing answers, and finding solutions to problems or questions.
2. Flexible thinking: Producing diverse ideas and responding with various answers or questions.
3. Original thinking: Generating new and unique expressions or ideas and being able to combine common elements into unusual combinations.
4. Elaboration ability: Enriching and developing ideas into more complex or detailed forms.

Based on Law No. 5 of 2017 on the Advancement of Culture, the Government aims to strengthen Indonesian National Culture in the era of globalization and views culture as an investment to build the nation's future and identity, per the principles contained in the 1945 Constitution. The diversity of regional cultures is considered a valuable asset and essential in enriching Indonesian National Culture in the context of dynamic world changes. To achieve this goal, strategic actions are needed to advance culture through Protection, Development, Utilization, and Nurturing to form an Indonesian society with political sovereignty, economic independence, and rich and diverse cultural diversity.

Education that prioritizes local wisdom is education that teaches students to stay connected with the concrete realities they experience. When students are faced with concrete problems and situations, they will be more motivated to respond critically. This view aligns with the findings of research conducted by Sae et al. (2021), which emphasizes that local wisdom has significant value for teachers in delivering learning to students because an educational approach based on local wisdom provides direct experiences. This argument is reinforced by research conducted by Matsun et al. (2020), which states that local wisdom, as part of the tradition in an area, will be more readily accepted by students, helping them to think, act, and behave according to the norms and values of the local culture.

According to Hasyim & Sujiono (2023), Based on their analysis, it was found that the use of the Ethno STEM-PjBL model influences the understanding of physics concepts. This is indicated by the improvement in higher-order thinking skills and the reduction of misconceptions on several physics topics related to student activities around Lake Tempe. This aligns with the findings of Martawijaya et al. (2023), which concluded that the local wisdom of water hyacinth fiber is considered suitable and feasible as an alternative material for making Songkok Recca.

In Indonesia, local wisdom has a meaning that is always interpreted positively because the term "wisdom" is often associated with good or positive connotations. From a classification standpoint, local wisdom can be divided into five categories, one of which is food. Traditional food refers to types of food and dishes that have been passed down through generations or have become part of the traditional consumption habits of the community over time. Traditional foods have characteristics that are connected to local history and culture, both at the national and regional levels. An example of this local wisdom is the traditional foods of South Sulawesi, such as "Pisang Epe" and "Coto". The diversity and dynamics of the South Sulawesi community are reflected in its diverse culinary culture. Almost every ethnic group residing in South Sulawesi has one or more types of food that are an integral part of their cultural identity.

Pisang Epe is a traditional food from South Sulawesi, Indonesia. Literally, "epe" means "pressed" or "flattened" in the Bugis-Makassar language, which is a local language in South Sulawesi. Pisang Epe is a banana that is flattened and then grilled over charcoal, resulting in a somewhat crispy texture on the outside but soft on the inside. It is then coated with liquid palm sugar.

Meanwhile, Coto, as a traditional food of Makassar, has been known since the time of the Gowa Kingdom. At that time, the Gowa Kingdom was centered in Sombaopu around 1538 AD, located in the southern part of Makassar city. Initially, Coto Makassar was a special dish served at the Gowa Kingdom's

palace. When there were important guests or during traditional ceremonies, Coto Makassar was often served. Coto Makassar, also known as Pallu Coto Mangkasarak, is a traditional dish of the Makassar ethnic group in South Sulawesi. This dish has a distinctive savory taste, made from beef offal that is boiled for a considerable time. After boiling, the beef offal is sliced and seasoned with specially prepared spices. Typically, Coto Makassar is served with ketupat, which is wrapped in coconut or pandan leaves.

Table 1. Local Wisdom in Physics Learning

Class	Local Wisdom	Identified Physics Topics
XI Science	*Pisang epe'*	• Pressure • Heat Conduction • Heating • Thermodynamics • Work
	Coto	• Ideal gas law • Temperature & time changes • Refraction of light • Energy conversion & heat transfer • Thermal insulation • Heat transfer Perpindahan kalor

Research on Creative Thinking Skills in Physics Learning, According to research conducted by Nurlaila et al. (2016), the average creative thinking skills score in physics for students of class XI IPA1 at SMA Negeri 2 Bua Ponrang falls into the low category, with a percentage of 46.88%. The analysis of creative thinking skill indicators shows that the indicator of identifying causes is the most dominant, with an average score of 2.70, while the indicator showing the consequences of an event is the lowest, with an average score of 0.95 compared to other indicators. Therefore, it can be concluded that the level of creative thinking skills in physics for students of class XI IPA1 at SMA Negeri 2 Bua Ponrang is still at a low level. Additionally, research conducted by Xi et al. (n.d.) found that the lowest category in the creativity analysis of students of class XI MIA 3 at SMA Negeri 11 Kota Jambi is the indicator of originality and flexibility, characteristics of creative problem-solving. Based on these findings, researchers have a solid rationale for conducting research aimed at analyzing "The Creative Thinking Skills of High School Students in Solving Physics Problems Based on Local Wisdom."

RESEARCH METHODOLOGY

This research uses quantitative descriptive methods. According to (Sugiyono, 2018), quantitative descriptive research analyzes data by describing or describing the collected data without intending to make conclusions that apply to the public-quantitative descriptive method whose data collection is done by test (Sugiyono, 2022). The school used as the research location is MAN 1 Makassar City. This research was conducted in the even semester of the 2023/2024 school year. The population in this study was 91 students of class XI MAN 1 Makassar City. The sampling technique in this study used purposive sampling. Purposive sampling is a sampling technique using specific considerations by the desired criteria to determine the number of samples studied. A total of 45 students of class XI MIPA at MAN 1 Makassar City were selected as samples because they knew local wisdom objects, namely banana epe' and Coto, both in terms of making and consuming directly.

The operational variables in this study are Creative thinking, which is the ability to analyze something based on data or information to generate new ideas for understanding something. Creative thinking in physics learning refers to the ability of students to generate original, innovative, and unconventional ideas, approaches, or solutions for understanding, applying, and connecting physics concepts. It involves thinking that is not limited by traditional or routine ways of learning, with four indicators of fluent thinking, flexible thinking, original thinking, and elaboration thinking.

The research process consisted of 3 stages. In the first stage involving the preparation of a research plan with guidance from the supervisor. The second implementation stage included organizing the test after agreement and permission were obtained from the school and physics subject teacher. In the final stage, researchers collected data from the school. After the data was collected, the data was then processed and analyzed by calculating the test score for each student.

The research instrument used is a test of 12 valid items from 16 items that have been validated by experts, where the first indicator consists of 2 items, the second indicator consists of 4 items, the third indicator consists of 3 items and the fourth indicator consists of 3 items. This test question is used for quantitative research data collection because test instruments measure a person's ability in a particular field. Moreover, data collection through interviews was carried out with semi-structured interviews. Semi-structured interviews are conducted to follow up on the results and look for factors that cause students' creative thinking abilities. Semi-structured interviews are only in the form of outlines of the problems asked, where the questions are prepared in advance but adapted to the unique circumstances and characteristics of the sample. The data collected from this study were processed using statistical analysis, namely descriptive statistics.

RESULT AND DISCUSSION

Result

1. Descriptive Statistical Analysis

a. Descriptive Score of Physics Creative Thinking Ability of Students of MAN 1 Makassar City

The research results were conducted on January 22 - February 05, 2024. Creative thinking skills are evaluated using a test consisting of 12 essay questions. The analysis results in this section include data on the physics creative thinking ability scores of 45 students. The data were then analyzed descriptively and processed using Microsoft Excel 2010. The results of descriptive statistical analysis of learners' creative thinking ability scores are presented in the following table:

Table 2. Statistical Results of Creative Thinking Ability of Students of MAN 1 Makassar City

Statistic	Statistic Value
Sample Size (n)	45
Maximum Ideal Score	48
Minimum Ideal Score	0
Maximum Empirical Score	37
Minimum Empirical Score	11
Score Range	31
Average Score	21,11
Variance	32,69
Standard Deviation	5,72

Table 2 above shows an overview of the creative thinking ability of MAN 1 Makassar city physics students. The data shows that the highest score is 37, and the lowest score is 11, so the average score of students' creative thinking ability is 21.11. The standard deviation of the data is 5.72.

Based on these data, presenting data into a frequency distribution table using the STURGEST formula, namely by determining the length of the class, the number of classes, and so on, namely by determining the highest score and subtracting it from the lowest score and adding it with a number one to determine the number of members (Highest score - lowest score + 1).

The description of the category of creative thinking ability of physics students in class XI MAN 1 Makassar City can be seen in the following table:

Table 3. Percentage of Frequency Distribution of Score Categorization of Creative Thinking Ability of Students of MAN 1 Makassar City

Score Interval	Frequency	Percentage (%)	Category
35 – 40	1	2	Very High
29 – 34	3	7	High
23 – 28	15	33	Medium
17 – 22	19	42	Low
11 – 16	7	16	Very Low
Total	**45**	**100**	

From Table 3 above, out of a total of 45 students, the highest frequency of 19 students, or about 42%, was classified in the low category. Therefore, the physics creative thinking ability of students at MAN 1 Makassar City tends to be in the low category. The factors that cause the students' physics creative thinking ability are the lack of understanding of physics concepts by students, which results in their difficulty in solving problems correctly, as well as lack of practice in answering creative questions. In addition, students' lack of interest or liking for physics subjects also affects their creative thinking ability test results.

Discussion

This study aims to assess the creative thinking ability of students at MAN 1 Makassar City by applying an essay test consisting of 12 questions. The method applied was descriptive quantitative, and the number of samples studied was 45 students, consisting of 25 students from class XI Mipa 3 and 20 students from class XI Mipa 5, according to the results of previous observations.

The results of descriptive statistical analysis of the physics creative thinking ability scores of MAN 1 Makassar City students, listed in Table 4.1, show that the average score obtained by 45 students is 21.11, with an empirical maximum score of 37 and an empirical minimum score of 11. The standard deviation of the score is 5.72. The data shows that the physics creative thinking score of MAN 1 Makassar City students is in the range of 17-22, with a frequency of 19, which indicates a low category. Based on the results of tests and interviews, the factors that cause students' physics creative thinking ability are due to the student's lack of understanding of physics concepts, which results in their difficulty in solving problems correctly, as well as lack of practice in answering creative questions. In addition, students' lack of interest or liking for physics subjects also affects their creative thinking ability test results. This finding aligns with research conducted by (Nurlaila et al., 2016), which concluded that students' creative thinking skills in physics are in the low category. This is due to the lack of student practice in solving creative problems, which results in difficulties in answering them. In addition, research conducted by (Xi et al., n.d.) also showed that students' creative thinking skills in original thinking were also in the low category. This is due to students' lack of understanding of basic concepts and lack of practice in responding to creative problems, so they have yet to be able to answer questions per indicator satisfactorily.

According to Piaget, at the high school cognitive development stage, students are expected to have reached the formal operational level, where they can recognize abstract concepts and concrete things. From the analysis above, students achieved an average score and a medium percentage in indicator 1 with a percentage of 44.17%, indicating that most students are only partially capable of thinking fluently. This is evident from their ability to generate many ideas, answers, and solutions to problems. This is by Munandar's (2017) view of fluent thinking indicators, which emphasizes that the ability to provide various answers to a problem indicates an adequate level of thinking. This finding also supports the results of research by (Xi et al., n.d.), which states that the ability to answer questions in a context has a relationship with understanding of learning materials. Therefore, the majority of learners can answer correctly on questions that require creative thinking.

In indicator 2, learners showed the ability to answer questions well and obtained a high score, reaching a percentage of 49.72%. Some learners were able to express diverse ideas and answers and consider various points of view. This is to Munandar's (2017) perspective on flexible thinking ability, which includes dealing with a problem from various points of view and producing various solutions. Support for

this finding was also revealed in a study conducted by (Mulder and Siswanto., 2023), which indicated that students could provide various answers. The results showed that the flexible thinking dimension reached the second-highest presentation.

In indicator 3, there are challenges for learners, as reflected in the low average score and percentage, which is only 27.22%. Many learners need help in original thinking, where they tend to provide no novelty solutions. This is due to the lack of practice of learners in answering questions that require creative and original thinking. In general, they only solve problems with pre-existing or expected answers. When given problems that require various approaches or new ideas, learners need help. According to Woolfolk's theory, having extensive knowledge is the basis for creative thinking because the greater a person's knowledge, the greater the possibility of generating new ideas. This aligns with the findings presented in research by Armandita et al. (2017), which showed that original thinking skills tend to be low due to students' lack of sensitivity to the problems given. Having sensitivity to the given problem is an essential factor in developing creative thinking skills, which in turn can generate new and original ideas that have not been thought of before.

In indicator 4, which recorded the highest average value and percentage compared to other indicators, 52.96%, many students answered the questions well. From this percentage, the elaborative thinking ability of students in solving problems is quite excellent and accurate. They have been able to describe in detail how to solve the problem and pay close attention to the steps given. Furthermore, when faced with physics problems based on local wisdom, they can process them well, starting by understanding the problems given and then elaborating, enriching, and developing ideas. This is by research findings by (Mulder & Siswanto., 2023), where detailed thinking skills enable learners to develop and enrich ideas and formulate problem-solving steps in detail. Therefore, the findings from the study indicate that learners have deep and detailed creative thinking skills (elaboration).

Based on the results of interviews conducted on February 13, 2024, show that most students need helplain the relationship between physics concepts in the problems given, as seen from several numbers of questions that students can answer in the study. In addition, students are also not familiar with the creative physics problems given, this is due to the lack of giving similar problems so that some students feel physics lessons are very difficult, students who tend to dislike physics learning will have difficulty understanding the lesson and answering questions. To produce students who are mostly at a low level, this raises interest and motivation in students to learn physics and apply it in everyday life.

Based on Wallas' theory, the analysis of the creative thinking ability of the subject learners is shown as follows at stage 1) Preparation, students try to recall the topic but still do not understand so they ask their friends and ask the researcher what the question means; 2) Incubation, students paused for a moment, began to read the problem over and over again, fell silent and began to fidget in finding a solution to the problem, and turned over the question paper and began to think again about how to solve the problem; 3) Illumination, students began to determine the answer after approximately 20 minutes and began to write problem-solving after several times flipping through the answer sheet; 4) Verification, students begin to write answers, begin to write down the known elements in the problem, write down some logic in solving problems in the problem but not yet appropriate, and there are errors in determining the conclusion of the proposed answer (problem-solving).

It is obtained significantly from the research data that when students work on problems, there are student behaviors that experience differences in the duration of time at the incubation, illumination, and verification stages. This study's results align with (Prayogi et al., 2021) on the effect of creative thinking skills on problem-solving, showing an influence between creative thinking skills and problem-solving. Based on the results of the students' analysis, there are differences in the time needed to provide problem-solving ideas. The duration of time required by the subject can determine the ability of students to think creatively. In addition to the incubation stage, at the illumination stage, students are slow in getting inspiration and ideas for problem-solving, and in the verification stage, students begin to write down problem-solving ideas. This stage is where the subject can re-examine the idea/solution that will be concluded. Based on interviews conducted by students who got low scores, information was obtained that students could not solve the problem above because they had never worked on similar problems. When

solving problems on the problem, students seemed to only look at the question sheet and answer sheet, thus indicating that students still needed help understanding the problem. When the author provides an analogy by helping students understand the problem, students seem unable to interpret the problem, so the proposed problem-solving is not correct.

CONCLUSION

Based on the findings of the research that has been conducted, the ability to think creatively in physics from students is categorized as low. Findings from the interviews also indicate that most students need help explaining the interrelationship of physics concepts in the problems given, as seen from several questions that students can answer in the study. In addition, students are also not familiar with the creative physics problems given; this is due to the lack of similar problems so that some students feel physics lessons are tough, and students who tend to dislike physics learning will have difficulty understanding the lesson and answering questions.

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