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# Inquiry learning model effects on students' creative thinking in sensory system material

**Sri Handayani Gea[1], Kartika Manalu[2]**
[1,2]Universitas Islam Negeri Sumatera Utara, Kota Medan, Indonesia
srihandayanigea@uinsu.ac.id[1]

**ABSTRACT**

Biology learning in various schools is still dominated by lecture and memorization methods that lack to develop students' creative thinking skills, especially in sensory system materials that require a deep understanding of concepts and practical applications. This study aims to analyze the influence of the inquiry learning model on the creative thinking ability of grade XI students of SMA Negeri 9 Medan on the sensory system material. The research method used is a quasi-experimental design with four classes as samples. Two experimental classes applied an inquiry learning model and two control classes used conventional learning. Data was collected through pretests and posttests that measured four indicators of creativity: fluency, flexibility, originality, and elaboration. The results showed a significant difference where the average posttest score of the experimental group was much higher than that of the control group, and showed a considerable difference. The results of the analysis showed that the data was normally distributed and had a homogeneous variance, so testing using the t-test could be carried out. These findings prove that the inquiry learning model is more effective in developing students' creative thinking skills because it provides opportunities to investigate, explore, and discover concepts independently, in contrast to conventional learning that relies solely on the transfer of information from teacher to student.

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***ABSTRAK***

*Pembelajaran Biologi di berbagai sekolah masih didominasi oleh metode ceramah dan hafalan yang kurang mengembangkan kemampuan berpikir kreatif peserta didik, terlebih khususnya pada materi sistem indra yang memerlukan pemahaman konsep mendalam dan aplikasi praktis. Penelitian ini bertujuan untuk menganalisis pengaruh model pembelajaran inkuiri terhadap kemampuan berpikir kreatif peserta didik kelas XI SMA Negeri 9 Medan pada materi sistem indra. Metode penelitian yang digunakan adalah quasi-experimental design dengan empat kelas sebagai sampel. Dua kelas eksperimen menerapkan model pembelajaran inkuiri dan dua kelas kontrol menggunakan pembelajaran konvensional. Data dikumpulkan melalui pretest dan posttest yang mengukur empat indikator kreativitas: kelancaran (fluency), fleksibilitas (flexibility), orisinalitas (originality), dan elaborasi (elaboration). Hasil penelitian menunjukkan perbedaan signifikan dimana rata-rata skor posttest kelompok eksperimen jauh lebih tinggi dibandingkan kelompok kontrol, serta menunjukkan selisih yang cukup besar. Hasil analisis menunjukkan bahwa data berdistribusi normal dan memiliki varians yang homogeny, sehingga pengujian menggunakan uji t dapat dilaksanakan. Temuan ini membuktikan bahwa model pembelajaran inkuiri lebih efektif dalam mengembangkan kemampuan berpikir kreatif peserta didik karena memberikan kesempatan untuk menyelidiki, mengeksplorasi, dan menemukan konsep secara mandiri, berbeda dengan pembelajaran konvensional yang hanya mengandalkan transfer informasi dari guru ke peserta didik.*

***Kata Kunci:*** *berpikir kreatif; model pembelajaran inquiry; sistem indra*

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## INTRODUCTION

Education is a main component. One of the very important learning skills in the 21st century to face global challenges is students' ability to think creatively. Creative thinking helps students in various aspects of life, including problem-solving and finding new solutions. However, many students face difficulties, particularly when they are required to think critically and devise new problem-solving approaches (Putri & Alberida, 2022). Problem-solving requires creative thinking, thereby helping students develop higher-order thinking skills. This creative thinking ability is referred to as Higher Order Thinking Skills (HOTS), which enable students to generate diverse ideas and solve problems (Adeoye & Jimoh, 2023; Fatmawati *et al*., 2022).

Biology is a branch of natural science that investigates life and living organisms, including their structure, function, growth, evolution, and distribution, as well as their interactions with their environment. As a broad field, biology encompasses disciplines such as genetics, ecology, microbiology, and biotechnology. This science plays an important role in understanding how living organisms adapt to their environments and how various biological processes occur within them. By understanding biology, humans can develop technology across fields such as health, agriculture, and environmental conservation. In addition, biology also plays a role in maintaining ecosystem balance by increasing human awareness of environmental conservation and the sustainability of natural resources.

Learning models are one alternative to improve students' creativity. The questioning approach emphasizes independent exploration of learning concepts, enabling students to engage in more active learning and better understand the material being taught (Putri & Zulyusri, 2022). The questioning method is a pedagogical approach in which students work in groups to answer questions through clearly and systematically outlined procedures, with or without teacher assistance. During this process, students are trained to ask a range of questions.

Several studies have shown that students' creative thinking can be improved through inquiry-based learning models in biology, which provide opportunities for students to discover and understand concepts through direct learning experiences (Cahaya *et al*., 2024). This is relevant to learning about the sensory system, which requires students not only to understand concepts but also to understand how the system operates scientifically (Marfilinda *et al*., 2025). In Grade IV at SDN 03 Simpang Haru, Padang City, particularly in IPAS classes, the questioning learning model can help students become more creative by providing opportunities to experiment, observe, and discuss new ideas. Previous studies have shown that the questioning learning model is effective in improving the creativity of biology students across various contexts. Research indicates that a guided inquiry learning approach can improve students' creativity and critical thinking skills in understanding biological concepts (Wahyuni & Witarsa, 2023). In addition, other studies show that implementing a question-based model can significantly improve students' creative skills. The results of this study prove that the inquiry model can be applied to senior high school students to improve their understanding of biology material (Putri & Alberida, 2022).



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Although several studies have shown that the questioning learning model can improve students' creative thinking abilities across various subjects, these studies primarily focus on its implementation in general contexts, without considering specific materials, such as the sensory system in biology. In addition, previous studies still lack discussion of how environmental factors can influence the effectiveness of the questioning model in improving students' creative abilities. Therefore, this study examines how the questioning learning model affects students' creative abilities, specifically with respect to the sensory system at SMA Negeri 9 Medan.

Biology instruction at SMA Negeri 9 Medan remains focused on lectures and memorization, which does not sufficiently support the development of students' thinking skills. This aligns with research findings showing that conventional learning methods often hinder students' ability to learn new concepts and think creatively (Suparmi, 2018). Interviews with Grade XI teachers indicate that learning models have been implemented. However, in practice, there are still obstacles to applying these models. One obstacle arises in a specific material, namely the sensory system material, in which students demonstrate a lack of creative thinking. In the sensory system material, the teacher has adopted a problem-based learning (PBL) model; however, based on the learning outcomes in Grade XI classes, some students still show low levels of creative thinking. The solution to biology learning problems that remain centered on lectures and memorization at SMA Negeri 9 Medan is to adopt a questioning learning model. This model encourages students to ask questions, learn, and develop their own ideas, thereby improving their critical and creative thinking skills. Teachers must be trained to design and implement question-based learning effectively, as they serve as facilitators who guide students' exploration.

This study aims to determine the extent to which the questioning learning model influences students' ability to think creatively about material on the sensory system at SMA Negeri 9 Medan. Based on this background, this study will determine the extent to which the questioning learning model influences students' ability to think creatively about material on the sensory system. The results of this study are expected to contribute to biology teaching methods and to improving the quality of education in senior high school institutions.

## LITERATURE REVIEW

### Inquiry Learning Model Theory

The inquiry learning model emphasizes the investigative process and students' discovery of concepts. The inquiry learning model is a series of learning activities that emphasizes critical and analytical thinking and enables students to independently seek and find answers to a posed problem (Prasetiyo & Rosy, 2021). This approach allows students to construct knowledge through direct experience and independent investigation, making learning more meaningful and more likely to be retained.

Several pieces of literature state that the indicators of creative thinking ability are as follows (Fauzi *et al*., 2019; Ibrahim & Widodo, 2020; Maryani *et al*., 2019; Wafa *et al*., 2025; Febrianingsih, 2022; Anindayati & Wahyudi, 2020):


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1. Fluency. This aspect is related to the way students find and construct various ideas. The fluency aspect refers to the variety of correct answers provided by students.
2. Flexibility. This aspect concerns the ability to solve problems in various ways. These different solution approaches begin with viewing the problem from different perspectives.
3. Originality. This aspect is related to the novelty of students in solving problems in unusual ways. The originality aspect needs to consider the appropriateness and usefulness of the answers.
4. Elaboration. This aspect concerns students' ability to explain the methods they have discovered in a systematic, detailed, and logical manner. The use of appropriate notation, terminology, and concepts needs to be considered in this aspect.

The inquiry model is designed to teach students how to investigate problems and questions based on facts. This model develops thinking abilities and research skills while also providing knowledge of the field under investigation. The main characteristics of the inquiry model include problem orientation, hypothesis formulation, data collection, hypothesis testing, and drawing conclusions based on the evidence obtained (Febrianti & Mufit, 2024).

## Creativity Theory in Learning

Creativity is the ability to engage in divergent thinking, which includes fluency, flexibility, originality, and elaboration (Adhiriyanthi *et al*., 2021). Creativity is described as a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so forth; identifying difficulties; seeking solutions, making guesses, or formulating hypotheses about these deficiencies (Torrance, 2023). In the context of learning, creativity can be cultivated within a learning environment that encourages curiosity, affords freedom of expression, and values students' unique ideas. Student-centered learning approaches, such as the inquiry model, can stimulate students' creativity by providing space for exploration, experimentation, and independent discovery (Munandar & Palennari, 2024).

## Constructivism Theory in Inquiry Learning

Constructivist theory provides a strong theoretical foundation for the inquiry learning model (Chand, 2023). According to this theory, knowledge cannot be simply transferred from teachers to students; rather, it must be constructed by students themselves through experience and interaction with the environment. Piaget emphasized that learning occurs when students actively build their own understanding through the processes of assimilation and accommodation. Vygotsky introduced the concept of the Zone of Proximal Development (ZPD), which indicates that students can achieve higher levels of learning with scaffolding from teachers or more competent peers. In the inquiry model, the teacher serves as a facilitator, providing minimal yet targeted guidance, allowing students to explore and discover concepts independently while remaining within a structured learning framework.


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### Problem-Based Learning Theory and Higher-Order Thinking Skills

Dewey, in his theory of reflective learning, emphasized the importance of "*learning by doing"* and of real problem-solving in the learning process. This theory aligns with the principles of the inquiry model, which emphasize learning through investigation and discovery. Henderson et al., in their study titled "Problem-Based Learning as an Authentic Assessment Method," further developed the concept of Problem-Based Learning (PBL), which shares similarities with the inquiry model in that it starts with authentic problems. In the revised Bloom's taxonomy, it is emphasized that developing Higher Order Thinking Skills (HOTS) is very important, including the abilities to analyze, evaluate, and create (Susilowati & Sumaji, 2021). The inquiry learning model inherently develops HOTS because students are required to analyze problems, evaluate information, and create new solutions or conclusions based on the results of their investigations (Rozali *et al*., 2024). This directly contributes to improving students' creativity, as research has shown.

## METHODS

This study employed a quantitative, quasi-experimental design. The study formed two nonequivalent control groups. The experimental group employed the questioning learning model, whereas the conventional control group employed the direct learning model. Pre- and post-treatment tests were conducted in both groups to assess improvements in students' creative thinking abilities. For this purpose, a nonequivalent control group design was used. Two groups of students were formed into an experimental group taught using the questioning model and a control group taught using the conventional learning model. **Table 1** below shows the control group design implemented.

**Table 1.** Control Group Design

| | ***Pretest*** | **Treatment** | ***Posttest*** |
|---|---|---|---|
| **E** | **O1** | **X** | **$O_2$** |
| **K** | **O3** | **-** | **$O_4$** |

*Source: Research 2025*

Specifications:
E : Experimental Class
K : Control Class
O1 : Pretest for Experimental Group
O2 : Posttest for Experimental Group
O3 : Pretest for Control Group
O4 : Posttest for Control Group O5
X : Treatment of Learning Model Questions

All Grade XI students at SMA Negeri 9 Medan during the 2024/2025 academic year were the subjects of this study, comprising 9 classes. The purposive sampling method was used to select four classes that had similar characteristics for the study. Classes XI-2 and XI-3 were assigned as the experimental groups, and classes XI-4 and XI-5 were assigned as the control groups. The data collection methods involved testing students' creative thinking abilities before and after the treatment, as well as observations to measure their engagement in questioning-based learning.


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The main instrument used was a test. There were two groups of students, namely the standard group and the experimental group. Students in the standard group were taught using the conventional learning model, while students in the experimental group were taught using the questioning model, consisting of fluency (smoothness in expressing concepts), flexibility (the ability to view various perspectives), originality (uniqueness of the proposed solutions), and elaboration (completeness in explaining ideas). This test was constructed based on a blueprint that had been tested and validated by education experts to ensure its credibility, in accordance with Kurniawan's (2016) opinion in his book *"Quantitative Research Methods."* Students' creative thinking abilities were assessed before and after the treatment using pretests and posttests with the formula shown in **Figure 1**. In addition, during the implementation of the Inquiry Learning Model, observations were conducted to monitor students' learning activities.

$$\text{Nilai} = \left( \frac{\text{Skor yang diperoleh}}{\text{Skor maksimal}} \right) \times 100$$

**Figure 1.** Formula for Value Calculation
*Source: Research 2025*

Students were classified according to their creative thinking, which was assessed using five criteria. The percentage of students' scores for each criterion is shown in **Table 2**.

**Table 2.** Criteria of Creative Thinking Ability

| Total Score Range (%) | Criteria for Thinking Skills |
|---|---|
| 81% - 100% | Very Creative |
| 61% - 80% | Creative |
| 41% - 60% | Moderately Creative |
| 21% - 40% | Less Creative |
| 0% - 20% | Not Creative |

*Source: (Qomariyah & Subekti, 2021)*

The data were analyzed using the Levene homogeneity test and the Kolmogorov–Smirnov normality test to assess normality and homogeneity. Finally, an independent-samples *t*-test was used to compare the mean pretest and posttest scores between the experimental and control groups.

## RESULTS AND DISCUSSION

### Analysis of Students' Creative Thinking Ability

A normality test was conducted to ensure that the data on students' improvement in mathematical critical thinking in the experimental and control groups followed a normal distribution. The analysis was carried out using the Kolmogorov–Smirnov and Shapiro–Wilk tests in SPSS version 25. Decision-making was based on the significance value; the data were deemed normally distributed if the significance value was greater than 0.05, as shown in **Table 3**.



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**Table 3.** One-Sample Kolmogorov-Smirnov Test

| Component | Experimental Class | | Control Class | |
|---|---|---|---|---|
| | ***Pretest*** | ***Posttest*** | ***Pretest*** | ***Posttest*** |
| Number of Students | 70 | 70 | 63 | 63 |
| Mean Score | 57 | 84,92 | 59 | 46,96 |
| Minimum Score | 40 | 70 | 20 | 50 |
| Maximum Score | 75 | 100 | 60 | 80 |
| Normality Test (Sig.) | 0,200 | 0,074 | 0,200 | 0,060 |
| Normality Conclusion | Normal | Normal | Normal | Normal |

*Sumber: Research 2025*

The results of the Kolmogorov–Smirnov normality test for the experimental and control classes, based on the data in **Table** 3, indicate that the significance values for both the pretest and posttest in each class are greater than 0.05. This indicates that the data are normally distributed. These findings serve as an important prerequisite for proceeding to the variance homogeneity test stage.

## Homogenitas

The homogeneity test determines whether the variances of two or more population groups are equal. The results of this test, known as the data homogeneity test, were calculated using SPSS version 25 and are presented here. If the significance level value is greater than 0.05, the data are considered homogeneous.

**Table 4.** Test of Homogeneity of Variance

| | | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| Creative Thinking | Based on Mean | 1,208 | 1 | 117 | 0,274 |
| | Based on Median | 0,848 | 1 | 117 | 0,359 |
| | Based on Median and with adjusted df | 0,848 | 1 | 103,818 | 0,359 |
| | Based on trimmed mean | 1,141 | 1 | 117 | 0,288 |

*Source: Research 2025*

Based on **Table 4**, the Levene test is not significant (sig > 0.05); namely, 0.288 > 0.05. Therefore, the data are homogeneously distributed.

## Hypothesis Testing (*t*-Test)

The homogeneity test evaluates whether the same variance is found in two or more population sample groups. The results of the data homogeneity test, conducted using SPSS version 25, are presented below. The data are considered homogeneous if the significance level is greater than 0.05.



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**Table 5.** Independent sample test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | |
|---|---|---|---|---|---|---|
| | | F | Sig. | t | Df | Sig. (2-tailed) |
| Creative Thinking | Equal variances assumed | 1,208 | 0,274 | -16,907 | 117 | 0,000 |
| | Equal variances not assumed | | | -16,723 | 107,309 | 0,000 |

*Source: Research 2025*

From the results of the paired *t*-test presented in **Table 5,** it can be concluded that Ha is accepted and H0 is rejected, as the p-value of 0.000 is less than 0.05. This indicates that students' creative abilities are significantly different before and after the implementation of the inquiry learning model.

## Analysis of Students' Creative Thinking

The level of students' creative thinking was analyzed using questionnaire results from two groups: the experimental class that used the inquiry model and the control class that used the traditional learning method. The questionnaire instrument was in the form of an essay test, with a score of 10 given for correct and appropriate answers, a score of 5 for less appropriate answers, and a score of 0 for incorrect or unanswered responses, which were then classified into the categories of very creative, creative, moderately creative, less creative, and not creative based on the total score. The treatment focused on the sensory system, and the study was conducted with Grade XI students at SMA Negeri 9 Medan to assess differences in learning motivation between the two groups. The distribution of students' learning motivation is presented in **Table 6**.

**Table 6.** Distribution Results of Students' Learning Motivation

| Total Score Range | Creative Thinking Ability Criteria | Control | Experimental |
|---|---|---|---|
| 81% - 100% | Very Creative | 0 | 40 |
| 61% - 80% | Creative | 15 | 30 |
| 41% - 60% | Moderately Creative | 41 | 0 |
| 21% - 40% | Less Creative | 7 | 0 |
| 0% - 20% | Not Creative | 0 | 0 |

*Source: Research 2025*

**Table 6** shows that in the experimental class, 40 students were in the very creative category, 30 in the creative category, and none were in the moderately creative, less creative, or not creative categories. Meanwhile, in the control class, no students were found in the very creative category; 15 students were categorized as creative; 41 students were categorized as moderately creative; 7 students were categorized as less creative; and no students were found in the not creative category.



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## Discussion

The improvement in students' creative thinking abilities in this study shows the most significant pattern in the moderately creative, very creative, and creative categories, followed by the less creative category. Based on the study results, the highest criterion of creative thinking ability was found in the moderately creative category, whereas the largest number of students was in the very creative category. This aligns with the theory that the inquiry model has advantages in influencing students' learning outcomes compared to conventional models, as in inquiry-based learning, students play an active role in the learning process, whereas in conventional models, the teacher tends to dominate (Dessani *et al*., 2025). One learning model that can make students active, critical, and enjoy learning is the inquiry model. The inquiry model is a learning model that emphasizes critical and analytical thinking processes to independently seek and find answers to a posed problem (Kerans *et al*., 2024). Conventional learning tends to make students passive in learning activities, including the creative thinking process, because they are not actively involved; as a result, their thinking processes are less developed, whereas the inquiry model encourages students to be more active in learning (Putri & Reinita, 2021).

The difference in mean scores between the two groups was strengthened by the results of statistical testing. The average learning outcome in the experimental class was 84.92, higher than that in the control class (46.96). The Mann-Whitney test produced an Asymp. Sig value of 0.00, which is below the 0.05 threshold, indicating a significant difference between the two groups. This fact shows that the inquiry model can help students solve problems more actively and creatively in science learning. Students are taught to use all of their abilities, especially mental processes, to find "self-concept" solutions critically and creatively (Risti & Ain, 2025). These findings are consistent with previous studies showing that inquiry-model-based learning can help students solve problems more actively and creatively in science learning (Risti & Ain, 2025). Students are taught to use all of their abilities, especially mental processes, to find "self-concept" solutions critically and creatively through the inquiry model (Andriana *et al*., 2021). The improvement in students' skills occurs because the inquiry model requires students to think creatively and critically in solving problems they face independently, thereby creating students who are intelligent and insightful, in accordance with the following definition: the inquiry learning model is "a teaching system that requires students to think critically with the aim of creating intelligent and insightful students" (Ginanjar *et al*., 2015). For example, a study found that applying the inquiry learning model significantly enhances students' classroom learning creativity (Marfilinda *et al*., 2025). Similar research also shows that the inquiry model can make students more active and creative in problem-solving, especially in science learning (Warmadewi, 2022).

Through the inquiry model, students are trained to use all of their potential (cognitive, affective, and psychomotor), especially their mental processes, to independently discover science concepts or principles like a scientist, so that students can develop "self-concept," critical thinking, and creativity. In contrast, the use of conventional learning models can be considered a cause of students' low creative thinking ability. This is because the learning process is oriented solely toward mastery of a number of information or concepts, with greater emphasis on memorization without being developed or examined in detail by the students, so that students' creative abilities are not trained, as students merely receive instructions without being given the opportunity to discover concepts on their own. As a result, students' creative potential cannot be developed.

Consistency in the findings is also evident in recent meta-analyses, which demonstrate that inquiry-based learning is more effective than conventional models in developing students' creative thinking abilities across various Biology learning contexts. The guided inquiry learning approach has been shown to enhance students' creativity and critical thinking skills in understanding biological concepts (Erni *et al*., 2023; Wahyuni & Witarsa, 2023). In addition, the implementation of inquiry-based models has been proven


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to significantly improve students' creative thinking skills (Putri & Zulyusri, 2022). The results of this study indicate that inquiry learning is not only relevant for higher-level education but can also be effectively applied at the senior high school level to improve students' understanding of Biology. This approach enables students to develop their creative thinking abilities and explore their individual potential more deeply (Prasetiyo & Rosy, 2021). This empirical evidence further strengthens the conclusion that the inquiry learning model is one of the most appropriate instructional approaches for sustainably enhancing creative thinking skills among senior high school students.

## CONCLUSION

The implementation of the inquiry model has been shown to improve students' creative thinking. The study found that students who participated in inquiry-based learning demonstrated higher creative thinking skills than those who received conventional instruction. Through the inquiry model, students are trained to utilize all of their potential (cognitive, affective, and psychomotor), especially their mental processes, to independently discover science concepts or principles like a scientist, enabling them to develop "self-concept," critical thinking, and creativity. Therefore, this approach is recommended as a strategic alternative to enhance the quality of Biology learning, particularly by fostering students' creative thinking competencies in a sustainable manner.

## AUTHOR'S NOTE

The study's results indicate challenges in implementing the inquiry learning model. Therefore, future research may focus on developing new strategies or modifications to this model to improve its effectiveness in enhancing creative thinking. The researchers suggest that further studies investigate additional components that influence the success or failure of efforts to improve students' creative thinking abilities.

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