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The Effect of Implementing the Card Sort Method on Fifth-Grade Students' Science Learning Outcomes in Animal Classification

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ABSTRACT : This study was motivated by the low science learning outcomes of elementary school students and the limited implementation of learning methods that actively engage students in the learning process, particularly in understanding conceptual material on animal classification. This study aimed to examine the effect of the Card Sort method on the science learning outcomes of fifth-grade students in animal classification material. A quantitative approach with a quasi-experimental method was employed using a Posttest-Only Nonequivalent Control Group Design. The sample was selected through total sampling and consisted of 56 students, including 29 students in Class VA as the experimental group, which received instruction using the Card Sort method, and 27 students in Class VC as the control group, which received instruction using the Make a Match model. Data were collected using a 20-item multiple-choice learning outcomes test. The instrument demonstrated good validity, with item correlation coefficients exceeding the r-table value of 0.367, and high reliability with a Cronbach's Alpha coefficient of 0.889. Data analysis included descriptive statistics, normality and homogeneity tests, and an Independent Samples t-Test using IBM SPSS Statistics Version 27. The results showed that the experimental group achieved a higher mean score (81.38) than the control group (70.74). The data were normally distributed and homogeneous, with a Levene's test significance value of 0.050. The Independent Samples t-Test yielded a significance value of 0.000 ($p < 0.05$), with a mean difference of 10.639. These findings indicate a significant difference in science learning outcomes between students taught using the Card Sort method and those taught using the Make a Match model. Therefore, the Card Sort method can be considered an effective active-learning strategy for improving elementary students' understanding and learning outcomes in animal classification.

Keywords: Card Sort Method, Science Learning Outcomes, Animal Classification, Active Learning, Elementary School.

INTRODUCTION

Elementary school education plays a fundamental role in developing students' potential across cognitive, affective, and psychomotor domains. At this level, the learning process is expected not only to provide students with factual knowledge but also to develop their ability to think critically, solve problems, communicate, collaborate, and apply knowledge in everyday life. In line with the implementation of the Independent Curriculum, Natural and Social Sciences (Ilmu Pengetahuan Alam dan Sosial/IPAS) constitutes an important subject that integrates scientific concepts with phenomena occurring in students' surrounding environments. Through IPAS learning,

students are expected to understand natural and social phenomena through meaningful, contextual, and active learning experiences.

The achievement of learning outcomes is one of the important indicators of the success of the learning process. Learning outcomes reflect the competencies achieved by students after participating in a series of learning activities, including cognitive, affective, and psychomotor aspects. However, in practice, learning outcomes are often still oriented primarily toward the cognitive domain and are measured through students' ability to remember information. This condition may result in learning that emphasizes memorization rather than conceptual understanding and the ability to apply knowledge. Low learning outcomes are often associated with the implementation of learning that is less varied and still dominated by teacher-centered methods, which can limit students' active participation in the learning process.

The development of students' scientific understanding also requires learning experiences that encourage them to actively observe, classify, analyze, and draw conclusions from the phenomena being studied. Parisu et al. (2025) emphasize the importance of developing scientific literacy among elementary school students through science learning that encourages students to understand scientific concepts and apply them in real-life contexts. Therefore, IPAS learning needs to be designed through learning strategies that provide opportunities for students to explore concepts and construct knowledge through direct experiences.

One relevant approach to addressing these challenges is active learning. Active learning directly engages students in the learning process through thinking, discussion, collaboration, classification, and problem-solving activities. Active involvement allows students to process information more deeply and develop a better understanding of the concepts being studied. One active learning method that can be applied is the Card Sort method. Card Sort is a learning method that uses cards containing information, concepts, characteristics, or categories that students must organize and group according to specific criteria. Through this activity, students have the opportunity to interact with learning materials, discuss with peers, exchange opinions, and make decisions based on their understanding.

The use of concrete and interactive learning activities is particularly relevant to science learning. Kasmawati et al. (2023) demonstrate the importance of developing innovative learning media in elementary school science learning to support students' understanding of scientific concepts. Similarly, the use of learning activities that involve the direct manipulation and classification of information can provide students with meaningful experiences. In this context, the Card Sort method is considered relevant because it transforms abstract information into concrete learning activities that can be observed, compared, grouped, and discussed by students.

Animal classification material in fifth-grade elementary school science learning requires students to understand the characteristics of living things and classify animals based on specific characteristics. This material is conceptual and requires students to understand relationships between characteristics and classifications rather than simply memorize information. Students may experience difficulties in understanding the material when learning is presented abstractly and is not supported by concrete and interactive learning activities. The Card Sort method provides an opportunity for students to actively classify information by grouping cards containing animal names, characteristics, and classification categories. Through this activity, students can develop their understanding by comparing information, identifying similarities and differences, discussing with group members, and determining the appropriate classification.

The implementation of the Card Sort method is also consistent with the principles of constructivist learning theory, which views knowledge as something actively constructed by students through interaction with their environment and learning experiences. In the Card Sort learning process, students are not merely recipients of information from the teacher. Instead, they are actively involved in organizing information, identifying relationships between concepts, discussing answers, and constructing their own understanding of animal classification. This learning process can encourage students to develop conceptual understanding while simultaneously increasing their participation in classroom activities.

The importance of active and student-centered learning in IPAS is also supported by the findings of Sisi et al. (2025) who reported that Discovery Learning and Inquiry Learning can influence students' IPAS learning outcomes by providing opportunities for students to actively investigate and discover concepts. These findings reinforce the view that learning strategies that involve students directly in the process of discovering and processing information can support the achievement of better learning outcomes. Although the Card Sort method has a different implementation mechanism, it has a similar emphasis on active student participation and the construction of understanding through learning activities.

Based on initial observations conducted at SDN 34 Kendari, particularly in Grade V, the science learning process on animal classification material was still predominantly conducted through lectures and question-and-answer activities. Students tended to be passive and showed limited involvement in learning activities. Some students also appeared to experience difficulties in distinguishing types of animals based on their characteristics and classification. This condition indicates the need for innovation in the learning process to increase student engagement and strengthen their conceptual understanding. The Card Sort method is considered

suitable for implementation because it provides an active, collaborative, and enjoyable learning experience. Through this method, students do not merely listen to the teacher's explanation but directly participate in grouping information and discussing the relationships between concepts.

In addition, the development of scientific literacy and conceptual understanding requires learning activities that encourage students to observe, classify, analyze, and communicate information. The Card Sort method provides a learning experience that is closely related to these skills because students are required to identify relevant characteristics and organize information into appropriate categories. Thus, the method has the potential to improve students' understanding of animal classification while supporting the development of active learning skills.

Several previous studies have supported the effectiveness of active and innovative learning approaches in improving student learning outcomes. Previous research has shown that the implementation of the Card Sort method can increase student activity and learning outcomes, as reflected in the improvement of students' average scores after the implementation of the method. Research on innovative science learning media has also demonstrated the importance of providing learning experiences that are more engaging, concrete, and interactive for elementary school students (Kasmawati et al., 2023). Furthermore, research on Discovery Learning and Inquiry Learning has shown that active learning models can contribute to the improvement of IPAS learning outcomes among elementary school students (Sisi et al., 2025).

Nevertheless, research specifically examining the effect of the Card Sort method on learning outcomes related to animal classification material among fifth-grade elementary school students remains limited, particularly in the context of SDN 34 Kendari. Therefore, this study seeks to provide empirical evidence regarding the effectiveness of the Card Sort method in improving students' learning outcomes in animal classification material. Based on this background, this research aims to determine the effect of implementing the Card Sort method on the science learning outcomes of fifth-grade students on animal classification material.

METHODS

This study employed a quantitative approach using a quasi-experimental method. The research design was a Posttest-Only Nonequivalent Control Group Design. This design was selected because the researcher could not randomly assign individual students to different groups, as the classes had already been formed by the school prior to the implementation of the research. Therefore, two existing classes

with relatively comparable academic characteristics were selected as the experimental and control groups.

The experimental group received learning treatment using the Card Sort method, whereas the control group received instruction using the Make a Match learning model. After the learning treatment was completed, both groups were administered the same posttest to measure their learning outcomes in the animal classification material. The research design can be described as follows:

Table 1. Posttest-Only Nonequivalent Control Group Design

Group	Treatment	Posttest
Experimental Group	X_1 (Card Sort Method)	O_1
Control Group	X_2 (Make a Match Model)	O_2

Information:

X_1 = Learning treatment using the Card Sort method

X_2 = Learning treatment using the Make a Match learning model

O_1 = Posttest results of the experimental group

O_2 = Posttest results of the control group

The research population consisted of all Grade V students of SDN 34 Kendari during the 2025/2026 academic year. The population comprised two classes with a total of 56 students. Because the population was relatively small and all members of the population could be involved in the study, a total sampling technique was employed. Accordingly, Class VA, consisting of 29 students, was designated as the experimental group and received learning treatment using the Card Sort method, while Class VC, consisting of 27 students, was designated as the control group and received instruction using the Make a Match learning model. Thus, the total sample consisted of 56 students.

The independent variable in this study was the implementation of the Card Sort learning method, while the dependent variable was the learning outcomes of Grade V students in the animal classification material. Data were collected using a learning outcomes test in the form of a multiple-choice instrument. The test consisted of 20 items. Each correctly answered item was assigned a score of 5, while an incorrect or unanswered item received a score of 0. The students' final scores were calculated using the following formula: Final Score = (Obtained Score / Maximum Score) × 100

The learning mastery criterion was based on the Minimum Completeness Criteria (KKM) established by the school. Students were considered to have achieved mastery if they obtained a score of ≥75.

Before being used in the main study, the learning outcomes instrument was tested on 29 respondents from another elementary school with characteristics similar to those of the research participants. The instrument testing consisted of validity,

reliability, and item difficulty analyses. The validity of each item was tested using the Product Moment correlation technique. An item was considered valid if the calculated correlation coefficient (r-count) was greater than the r-table value at a significance level of 5%. The reliability of the instrument was assessed using Cronbach's Alpha. The instrument was considered reliable if the Cronbach's Alpha coefficient was greater than 0.60. In addition, an item difficulty analysis was conducted using the difficulty index (P) to determine whether each test item was categorized as easy, moderate, or difficult.

The data analysis was conducted in three stages. First, descriptive statistical analysis was used to provide an overview of the learning outcomes obtained by students in the experimental and control groups. The descriptive analysis included the number of students, minimum score, maximum score, mean score, and standard deviation. Second, prerequisite tests were conducted before hypothesis testing. The normality of the data was examined using the Shapiro–Wilk test. The data were considered normally distributed if the significance value was greater than 0.05. Homogeneity of variance was tested using Levene's test, with data considered homogeneous if the significance value was greater than 0.05.

Third, because the data met the assumptions of normality and homogeneity, hypothesis testing was conducted using the Independent Samples t-test. This test was used to determine whether there was a statistically significant difference in learning outcomes between students who received instruction using the Card Sort method and those who received instruction using the Make a Match learning model. The decision-making criteria were that if the significance value (Sig. 2-tailed) was less than 0.05, H_o was rejected and H_a was accepted, indicating a significant difference in learning outcomes between the two groups. Conversely, if the significance value was greater than 0.05, H_o was not rejected. All statistical analyses were performed using IBM SPSS Statistics Version 27.

RESULT AND DISCUSSION

RESULT

A. Results of Research Instrument Testing

Before the instrument was used to measure students' learning outcomes, an instrument trial was conducted to ensure that the test items met the requirements of validity, reliability, and appropriate difficulty level. The instrument consisted of 20 multiple-choice questions and was tested on 29 respondents who had characteristics similar to those of the research sample. The validity test was conducted using the Product Moment correlation technique at a significance level of 5%. With degrees of freedom (df) = 27, the r-table value was 0.367.

The results showed that the calculated correlation coefficients for all 20 items were greater than the r-table value, with values ranging from 0.419 to 0.672. Therefore, all items were declared valid and suitable for measuring students' learning outcomes on the animal classification material.

Table 2. Summary of Research Instrument Validity Test Results

Item	r-count	r-table	Decision
1	0.578	0.367	Valid
2	0.641	0.367	Valid
3	0.625	0.367	Valid
4	0.612	0.367	Valid
5	0.460	0.367	Valid
6–14	0.419–0.672	0.367	Valid
15	0.419	0.367	Valid
16–19	0.419–0.672	0.367	Valid
20	0.641	0.367	Valid

Based on Table 2, all 20 test items obtained an r-count greater than the r-table value of 0.367. The lowest correlation coefficient was 0.419, while the highest was 0.672. Thus, all items met the criteria for validity and were retained for use as the posttest instrument.

The reliability test was conducted using Cronbach's Alpha. The analysis produced a coefficient of 0.889 for the 20 test items. Since the coefficient was greater than 0.60, the instrument was categorized as reliable and demonstrated a high level of internal consistency. This indicates that the instrument was consistent in measuring students' learning outcomes.

The item difficulty analysis showed that 15 items, or 75%, were categorized as easy, while 5 items, or 25%, were categorized as moderate. No items were classified as difficult. Although the majority of the items were categorized as easy, the test items remained appropriate for measuring students' understanding of the animal classification material because they had previously met the requirements for validity and reliability. Therefore, all 20 items were used as the posttest instrument in the main research.

B. Descriptive Statistics of Science Learning Outcomes

The descriptive analysis was conducted to provide an overview of the learning outcomes of students in the experimental and control groups after the learning process. The experimental class, Class VA, consisted of 29 students and received instruction using the Card Sort method. Meanwhile, the control class, Class VC,

consisted of 27 students and received instruction using the Make a Match learning model.

The descriptive statistics of students' learning outcomes are presented in Table 3.

Table 3. Descriptive Statistics of Science Learning Outcomes

Statistic	Experimental Class (VA)	Control Class (VC)
N	29	27
Mean	81.38	70.74
Median	80.00	70.00
Mode	85	75
Standard Deviation	8.954	6.156
Minimum	65	60
Maximum	100	85
Average Category	Good	Sufficient

As shown in Table 3, the experimental class obtained an average learning outcome score of 81.38, while the control class obtained an average score of 70.74. The difference in the average scores indicates that students who learned using the Card Sort method achieved higher learning outcomes than students who learned using the Make a Match model.

The experimental class also obtained a maximum score of 100, whereas the highest score in the control class was 85. The standard deviation of the experimental class was 8.954, which was higher than the control class's standard deviation of 6.156. This indicates that the distribution of scores in the experimental class was more varied. Nevertheless, the overall achievement of the experimental class tended to be higher, as reflected in its greater mean score.

To provide a more detailed description of student achievement, the learning outcome scores were subsequently classified into four categories: low, moderate, high, and very high.

Table 4. Frequency Distribution of Learning Outcome Categories

Category	Experimental Class (f)	Experimental (%)	Control Class (f)	Control (%)
Low	5	17.2	16	59.3
Moderate	10	34.5	10	37.0
High	11	37.9	1	3.7
Very High	3	10.3	0	0.0
Total	29	100.0	27	100.0

Table 4 shows that the distribution of student learning outcomes differed considerably between the two groups. In the experimental class, 11 students (37.9%) were categorized as having high learning outcomes, while 3 students (10.3%) were categorized as having very high learning outcomes. Thus, a total of 14 students, or 48.2%, achieved high to very high learning outcomes.

In contrast, the control class was dominated by students in the low category, with 16 students (59.3%). Only one student (3.7%) was included in the high category, and no students achieved the very high category. These findings provide an initial indication that the application of the Card Sort method resulted in better learning outcomes than the Make a Match model.

C. Results of Prerequisite Analysis

Before hypothesis testing was conducted, prerequisite tests were performed to determine whether the data met the assumptions required for parametric statistical analysis. The prerequisite tests consisted of a normality test and a homogeneity test.
The normality test was conducted using the Shapiro–Wilk test because the number of respondents in each group was fewer than 50. The results are presented in Table 5.

Table 5. Results of the Shapiro–Wilk Normality Test

Group	Shapiro–Wilk Statistic	df	Sig.
Experimental	0.967	29	0.481
Control	0.936	27	0.096

Based on Table 5, the significance value obtained for the experimental class was 0.481, while the control class obtained a significance value of 0.096. Both significance values were greater than 0.05. Therefore, the learning outcome data from both groups were normally distributed. This result indicates that the normality assumption required for the use of parametric statistical tests was fulfilled.
After the normality test, a homogeneity test was conducted using Levene's Test to determine whether the variances of the two groups were homogeneous.

Table 6. Results of the Homogeneity Test

Levene Statistic	Sig.	Information
4.014	0.050	Homogeneous

The results in Table 6 show a significance value of 0.050. Based on the decision criterion that data are considered homogeneous when the significance value is greater than or equal to 0.05, the variance of the two groups can be considered homogeneous. Thus, the data fulfilled the prerequisite assumptions for further analysis using the Independent Samples t-test.

D. Results of Hypothesis Testing

Hypothesis testing was conducted to determine whether there was a significant difference in learning outcomes between students who were taught using the Card Sort method and students who were taught using the Make a Match model. Because the data were normally distributed and had homogeneous variances, the Independent Samples t-test was used.

The results of the hypothesis test are presented in Table 7.

Table 7. Results of the Independent Samples t-Test

t-count	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval
5.144	54	0.000	10.639	6.492–14.785

Based on Table 7, the Independent Samples t-test produced a t-count of 5.144 with 54 degrees of freedom and a significance value of 0.000. Since the significance value was less than 0.05 (0.000 < 0.05), the null hypothesis (H_o) was rejected and the alternative hypothesis (H_a) was accepted. This result indicates that there was a statistically significant difference in learning outcomes between students who learned using the Card Sort method and those who learned using the Make a Match model.

The mean difference between the two groups was 10.639 points, indicating that the learning outcomes of the experimental class were higher than those of the control class. Furthermore, the 95% confidence interval ranged from 6.492 to 14.785 and did not include zero, further confirming that the difference between the two groups was statistically significant.

Therefore, it can be concluded that the implementation of the Card Sort method had a significant effect on the learning outcomes of fifth-grade students in science learning, particularly on the topic of animal classification. The higher average score obtained by the experimental class indicates that the Card Sort method was more effective than the Make a Match model in supporting students' understanding of the material.

DISCUSSION

The results of this study demonstrate that the implementation of the Card Sort method produced a statistically significant difference in the learning outcomes of fifth-grade students compared with the Make a Match model. The experimental class, which received instruction through the Card Sort method, achieved a mean score of 81.38, categorized as good, whereas the control class, which received instruction through the Make a Match model, achieved a mean score of 70.74, categorized as sufficient. The difference of 10.64 points between the two groups was statistically significant, as demonstrated by the Independent Samples t-test, which yielded a significance value of 0.000 ($p < 0.05$). These findings indicate that the difference in

learning outcomes was not merely incidental but was associated with differences in the learning methods implemented in the two classes.

The effectiveness of the Card Sort method can also be observed from the distribution of students' learning outcomes. In the experimental class, 48.2% of students achieved high to very high learning outcomes, including several students who obtained the maximum score of 100. Meanwhile, in the control class, 59.3% of students remained in the low category, and no students reached the very high category. This distribution indicates that the Card Sort method was able to encourage a greater proportion of students to achieve higher levels of understanding of the animal classification material.

The higher learning outcomes in the experimental class can be explained by the characteristics of the Card Sort method, which actively involves students in the learning process. Through this method, students are required to identify, compare, discuss, and classify information presented on cards based on the characteristics of different animals. The learning process does not merely require students to receive information from the teacher but encourages them to directly process and organize information. As a result, students are given greater opportunities to construct their understanding through active learning experiences.

This finding is consistent with Silberman's (2013) perspective that active learning strategies are effective because they engage students both physically and mentally. In the Card Sort method, students participate in activities involving movement, observation, discussion, decision-making, and classification. Such activities are particularly relevant to animal classification material because students are required to understand similarities and differences among animals and group them based on specific characteristics. Consequently, abstract concepts can be transformed into more concrete learning experiences.

The effectiveness of the Card Sort method is also consistent with constructivist learning theory. Constructivism views learning as an active process in which students construct knowledge through direct experience and interaction with their environment. In this study, students did not simply memorize animal classification concepts. Instead, they were actively involved in identifying the characteristics of animals and organizing information into appropriate categories. This process enabled students to develop understanding through their own learning experiences.

The findings also support the importance of active and meaningful learning in science education. Parisu et al. (2025) emphasize the importance of developing scientific literacy among elementary school students through learning experiences that encourage students to understand scientific concepts and relate them to their surroundings. Animal classification material provides an appropriate context for

developing such understanding because students must identify observable characteristics and use scientific concepts to classify living organisms. Therefore, the Card Sort method can support not only the achievement of learning outcomes but also the development of students' scientific reasoning.

The use of concrete and interactive learning resources also strengthens the effectiveness of the learning process. Kasmawati et al. (2023) demonstrated that the development of innovative learning media can support the delivery of science material and make learning more engaging for elementary school students. Although the present study used a Card Sort method rather than a Prezi-based medium, both approaches share a common principle: learning becomes more effective when students are actively engaged with information through meaningful and interactive learning activities.

In contrast, the control class, which used the Make a Match model, obtained a lower average score of 70.74. Although Make a Match also involves student participation, its primary activity focuses on finding matching pairs of questions and answers. This activity can create an enjoyable learning atmosphere; however, the depth of conceptual processing may be more limited when compared with the Card Sort method. Students primarily focus on identifying the appropriate pair, whereas the Card Sort method requires students to analyze characteristics and organize several pieces of information into a broader classification system.

The difference between the two learning approaches is also reflected in the distribution of scores. The control class had a lower standard deviation of 6.156 compared with 8.954 in the experimental class. This indicates that the scores in the control class were more concentrated within a relatively narrow range, whereas the experimental class showed greater variation in achievement. However, the higher mean score of the experimental class indicates that the overall level of achievement was substantially better. This finding suggests that the Card Sort method provided greater opportunities for students to achieve higher learning outcomes.

The results of this study are also consistent with the findings of Sisi, Parisu, and Aopmonaim (2025), who reported that active learning models such as Discovery Learning and Inquiry can influence students' IPAS learning outcomes by encouraging them to explore, investigate, and construct knowledge independently. Similar principles are present in the Card Sort method, particularly in the process of identifying information, discussing concepts, and determining appropriate classifications. These activities encourage students to become active participants in the learning process rather than passive recipients of information.

The effectiveness of the Card Sort method is particularly relevant to animal classification material. The material requires students to understand the

characteristics of animals and group them according to specific criteria. Therefore, a learning method that directly involves students in grouping and organizing information is considered appropriate. Through the Card Sort activity, students can observe the information presented on cards, compare characteristics, discuss their findings with classmates, and determine the appropriate classification. This learning process enables students to understand concepts through direct experience and repeated interaction with the material.

Furthermore, the collaborative nature of the Card Sort method creates opportunities for students to exchange ideas and clarify their understanding through discussion. Students who initially experience difficulty in understanding the characteristics of certain animals can obtain assistance from their peers and the teacher during the classification process. This interaction supports the development of communication and reasoning skills while simultaneously strengthening conceptual understanding.

Based on the findings, the difference between the two groups demonstrates that the selection of a learning method should be adapted to the characteristics of the subject matter and the learning needs of students. The Card Sort method is particularly appropriate for material that involves classification, comparison, and categorization. Its application enables students to actively process information, construct their own understanding, and connect concepts through direct learning experiences.

Therefore, the findings of this study confirm that the Card Sort method has a significant positive influence on the learning outcomes of fifth-grade students in animal classification material. The method was more effective than the Make a Match model in improving students' learning outcomes, as evidenced by the higher average score of the experimental class and the statistically significant difference between the two groups. The Card Sort method can consequently be considered an effective alternative for creating active, collaborative, and meaningful science learning in elementary schools.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the implementation of the Card Sort method had a significant positive effect on the science learning outcomes of fifth-grade students on the animal classification material. Students in Class VA, who received learning through the Card Sort method, achieved an average score of 81.38, which was categorized as good. Furthermore, 48.2% of students in the experimental class achieved high to very high learning outcomes. In comparison, students in Class VC, who were taught using the Make a Match model,

obtained an average score of 70.74, categorized as sufficient, with 59.3% of students remaining in the low category.

The results of the Independent Samples t-test produced a significance value of 0.000 ($p < 0.05$), with a mean difference of 10.639 points between the two groups. Therefore, the null hypothesis (H_o) was rejected and the alternative hypothesis (H_a) was accepted. These findings confirm that there was a statistically significant difference in learning outcomes between students taught using the Card Sort method and those taught using the Make a Match model. Thus, the Card Sort method was proven to be more effective in improving students' science learning outcomes on animal classification material.

Based on these findings, teachers are recommended to consider the Card Sort method as an alternative active learning strategy, particularly for science materials involving classification, grouping, comparison, and identification of characteristics. To maximize its effectiveness, teachers should prepare clear, varied, and visually appealing cards that are appropriate to students' cognitive development and learning objectives. The learning activities should also be accompanied by group discussions and teacher guidance to ensure that students do not merely group the cards but also understand the scientific concepts underlying the classification process.

Schools are also expected to support the implementation of innovative learning through the provision of appropriate learning resources and professional development opportunities for teachers, particularly training related to active and student-centred learning strategies. For future researchers, the scope of this study can be expanded by involving a larger number of schools and respondents, applying the Card Sort method to different science or IPAS topics, and comparing it with other learning models. Further research may also examine the influence of the Card Sort method on other learning outcomes, such as scientific literacy, critical thinking skills, problem-solving abilities, student engagement, and long-term retention of learning materials.

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