



## THE EFFECT OF DIFFERENTIATED LEARNING STRATEGIES ON GRADE VIII STUDENTS' LEARNING OUTCOMES IN HUMAN RESPIRATORY SYSTEM TOPIC

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### Abstract

This study aimed to examine the effect of differentiated learning strategies on Grade VIII students' learning outcomes in the human respiratory system topic at SMPN 9 Banjarmasin. A quasi-experimental design was employed involving two intact classes: class VIII A as the experimental group (n = 31) and class VIII C as the control group (n = 35), with a total of 66 students. The experimental group received instruction using differentiated learning strategies based on content, process, and product differentiation, while the control group received conventional instruction. Data were collected using a 20-item multiple-choice learning outcome test administered as a pre-test and post-test. The instruments were validated using the Pearson Product Moment validity test, and reliability was measured using Cronbach's Alpha. The data were analyzed using descriptive statistics, normality and homogeneity tests, ANCOVA, and the Mann-Whitney test. Because the post-test scores did not meet the homogeneity assumption, the Mann-Whitney test was used as the final hypothesis test. The results showed a statistically significant difference in post-test scores between the experimental and control groups (Sig. = 0.000 < 0.05), with the experimental group achieving a higher mean score (71.13 vs. 49.29). The ANCOVA results also indicated a large effect size for the treatment variable (partial  $\eta^2 = 0.354$ ). These findings suggest that differentiated learning strategies may support students' learning outcomes in science, particularly in the human respiratory system topic. However, the initial difference in pre-test means between the groups (46.61 vs. 33.86) should be considered a limitation when interpreting these results.

**Keywords:** differentiated learning; human respiratory system; learning outcomes; Mann-Whitney test; quasi-experimental design

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## INTRODUCTION

The innovative learning approach within the independent curriculum offers educators the freedom to design instructional and evaluation frameworks that align with student characteristics and requirements. This contemporary learning model guarantees learner-focused educational practices through differentiated instruction. Differentiated instruction aligns with Ki Hajar Dewantara's educational philosophy, which states that education (*opvoeding*) offers direction for all innate capabilities within students, enabling them to reach optimal well-being and fulfillment as individuals and community members. Consequently, educators serve as facilitators who nurture the development of students' inherent abilities, helping to enhance their conduct (rather than their foundation) while fostering their natural potential (Naibaho, 2023).

Actually, the identification findings revealed that the execution of educational activities has shown minimal transformation from an instructional approach that treats all learners uniformly without acknowledging the variation in their capabilities (Iskandar, 2021). According to observation findings during the Teaching Assistance programs conducted by researchers at SMP Negeri 9 Banjarmasin, there existed varied student learning approaches. The student learning approach survey results indicated three distinct categories: visual, audio-visual, and kinesthetic modalities. This diversity cannot be uniformized since every learner possesses unique traits, requirements, and educational preferences. Student learning approaches influence how learners favor comprehending subject matter effectively (Purba et al., 2021). Thus, educators must assess students to select appropriate strategies for classroom instruction

However, in reality, based on the researcher's observations during the Teaching Assistance activities, teachers lack variety in carrying out learning activities and tend to use the lecture method. This uniform and unidirectional instructional approach frequently fails to address the personalized educational requirements of learners who possess varying learning preferences. The lecture method makes students bored more quickly, uninterested in the lesson, and less able to develop their curiosity (Rasman et al., 2022). This causes students to have less understanding of the concept of science learning because this lecture method ignores the diverse needs of individuals, such as the requirements of learners who have a visual learning preference that requires illustrations and pictures, an audio-visual learning style that requires verbal explanations accompanied by audio-visual media, and a kinesthetic learning style

that requires physical activity and object manipulation. Without a more interactive approach that suits individual learning styles, students tend to have difficulty connecting theory with practice, resulting in shallow understanding and a lack of ability to apply the concepts that have been learned in everyday life.

The learning process that places the teacher as the main facilitator can reduce more dynamic interactions between the teacher and students. This can cause students to feel less actively involved during the instructional process, causing them to become inactive. This makes students consider science subjects less interesting. Consequently, learners' enthusiasm for studying decreases and has an impact on learning outcomes that are not optimal. Therefore, it is important for educators to choose learning strategies that are more varied, interactive, and aligned with learners' requirements and capabilities.

Beyond variations in learning preferences, according to academic performance data from grade VII A and VII C pupils at SMPN 9 Banjarmasin during the end-of-term evaluation for the 2023/2024 school year, it was observed that merely 23% of students achieved completion. Reviewing the various factors that cause low student learning outcomes, it is necessary to play a role in the learning approach employed during instruction in scientific content which will help improve student learning outcomes. Therefore, in this problem, to enhance learners' academic performance, it is essential to implement a differentiated learning strategy. Differentiated learning helps students' learning needs to improve learning outcomes. Through differentiated learning, teachers are required to pay full attention and produce a treatment procedure to fulfill learners' educational requirements, understand students' weaknesses and abilities when learning (Sitorus et al., 2022).

Differentiated instructional approach is an educational method that is customized to address the requirements, capabilities, preferences, and learning modalities of individual students. The purpose of differentiated learning is to ensure that each student gets an optimal learning experience and is in accordance with their individual needs, enabling them to attain optimal academic achievements. Differentiated instruction employs diverse methodologies (varied approaches) in subject matter, procedures, and outcomes. Educators will focus on three crucial components of differentiated instruction within the classroom setting, specifically: first, subject matter (input) concerning what learners study; second, procedures (process) regarding how students will acquire information and develop concepts about their

learning material; third, outcomes (output) demonstrating how learners will exhibit their acquired knowledge (Purwowidodo, 2023).

While global studies have demonstrated the effectiveness of differentiated instruction (Tomlinson, 2021; Smale-Jacobse et al., 2019; Lee & Cho, 2023), empirical evidence from Indonesia, particularly in middle school science contexts, remains scarce. Most previous Indonesian studies were limited to descriptive classroom action research without quasi-experimental validation. This study addresses that gap by applying a quasi-experimental design to examine differentiated learning effectiveness on students' understanding of the human respiratory system.

The respiratory system encompasses the mechanism through which oxygen is absorbed, carbon dioxide is expelled, and energy is utilized. This system comprises the nasal passages, throat, voice box, windpipe, bronchial network, and lung tissues. (Aji et al., 2019). The human respiratory system material was chosen for the study of differentiated learning strategies because it is multidimensional, includes abstract biological concepts and requires an understanding of complex physiological mechanisms. This topic is ideal for differentiated learning because it can be studied from various perspectives that are relevant to the differences in students' learning styles. For example, students who have a visual tendency can understand the structure of the lungs through diagrams or 3D models, students with an auditory learning style can more easily understand abstract concepts such as the mechanism of oxygen and carbon dioxide exchange by listening to clear and detailed verbal explanations from teachers or

through audio recordings that illustrate this physiological process, while students who prefer a kinesthetic approach can engage in simulations or experiments that illustrate the respiratory process.

According to the foundation and theoretical frameworks outlined previously, the investigator is motivated to undertake a study entitled "The Effect of Implementing Differentiated Learning Strategies on the Learning Outcomes of Class VIII Students of SMPN 9 Banjarmasin on the Human Respiratory System Material".

**METHOD**

This investigation employs a quantitative research approach utilizing an experimental methodology. As stated by Sugiyono (2017), the experimental methodology represents a quantitative research technique applied to examine the influence of independent variables (interventions) on dependent variables (results) within controlled environments. The framework implemented in this investigation is a quasi-experimental framework.

**Research Design**

A quasi-experimental framework represents a research structure designed to establish whether there exists an impact or influence of a particular factor affecting the participants, specifically learners. This investigative approach incorporates two groups that receive distinct interventions to assess academic performance in human respiratory system content, with both groups undergoing evaluations to measure their capabilities. The structure of this research framework is presented in table 1.

**Table 1.** Research design

<b>Class</b>	<b>Pre-test</b>	<b>Treatment</b>	<b>Post-test</b>
Experiment Class	O <sub>1</sub>	X <sub>a</sub>	O <sub>2</sub>
Control Class	O <sub>3</sub>	X <sub>b</sub>	O <sub>4</sub>

**Information:** O<sub>1</sub> : Pre-test of experiment class; O<sub>2</sub> : Post-test of experiment class; O<sub>3</sub> : Pre-test of control class; O<sub>4</sub> : Post-test of control class; X<sub>a</sub> : Treatment using differentiated learning strategy; X<sub>b</sub> : Treatment using conventional learning

**Research Objectives**

The study population comprised all eighth-grade pupils at SMPN 9 Banjarmasin. The research participants utilized were learners from classes VIII A and VIII C, with the overall sample including 31 pupils from class VIII A and 35 pupils from class VIII C, resulting in a total sample size of 66 learners. Class VIII A was assigned as the experimental group and class VIII C as the control group based on purposive sampling, because both classes had comparable academic characteristics and available pre-test and post-test data from the prior semester. It should be noted that, since intact

classes were used, the two groups were not randomly assigned, which is a limitation of this design. As will be discussed in the results section, the pre-test scores revealed an initial difference between the groups that must be considered when interpreting findings.

The study population comprised all eighth-grade students at SMPN 9 Banjarmasin. The sample included 31 students from class VIII A (experimental group) and 35 students from class VIII C (control group), totaling 66 participants. Purposive sampling was employed because the selected classes met the research criteria: both

classes had available academic performance data and comparable academic profiles based on the previous semester's results. The study was conducted at SMPN 9 Banjarmasin, Jl. Batu Benawa Raya No. 29, RT. 76 Teluk Dalam, Banjarmasin City, South Kalimantan, during the First Semester of the 2024/2025 Academic Year.

#### Data Collection Technique

Data were collected using a learning outcome test consisting of 20 multiple-choice items covering the human respiratory system topic, administered as both a pre-test (before instruction) and a post-test (after instruction). Each correct answer was scored 5 points, and incorrect answers received 0 points, yielding a maximum score of 100. The pre-test was used to establish students' baseline knowledge, while the post-test was used to evaluate learning outcomes after the intervention.

Instrument validity was assessed using the Pearson Product Moment validity test with IBM SPSS Statistics 21 software. An item was considered valid if the significance value (Sig.) was below 0.05 (Sujarweni, 2014). Instrument reliability was measured using Cronbach's Alpha;

## RESULTS AND DISCUSSION

### Descriptive Statistics

Pre-test and post-test scores from the experimental and control groups were collected

the instrument was deemed reliable if the Cronbach's Alpha coefficient exceeded 0.70 (Sugiyono, 2012).

### Data Analysis Technique

The data analysis procedure followed these sequential steps: (1) descriptive statistics were computed for pre-test and post-test scores of both groups, including mean, maximum score, minimum score, standard deviation, and variance; (2) the Kolmogorov–Smirnov normality test was conducted to determine whether the data were normally distributed; (3) an overall homogeneity test (Levene's test) was conducted across all four data sets (pre-test and post-test of both groups) to examine general variance equality; (4) ANCOVA was conducted with pre-test scores as the covariate to examine whether initial differences between the groups influenced the post-test comparison; (5) a post-test homogeneity test was conducted specifically between the two groups' post-test scores to determine the appropriate final hypothesis test; and (6) because the post-test homogeneity assumption was not met, the Mann–Whitney non-parametric test was used as the final hypothesis test.

using a 20-item multiple-choice instrument. Table 2 presents the descriptive statistics for both groups.

**Table 2.** Descriptive statistics of pre-test and post-test scores

Information	Control Class		Experiment Class	
	<i>Pre-test</i>	<i>Post-test</i>	<i>Pre-test</i>	<i>Post-test</i>
<i>Mean</i>	33.86	49.29	46.61	71.13
Maximum Score	60	65	75	90
Minimum Score	10	30	25	50
Standard Deviation	11.825	13.457	10.359	9.722
Variance	139.832	181.092	107.312	94.516

As shown in Table 2, both groups demonstrated an increase in mean scores from pre-test to post-test. The control group's mean increased from 33.86 to 49.29, while the experimental group's mean increased more substantially, from 46.61 to 71.13. It is important to note that the experimental group's pre-test mean (46.61) was considerably higher than that of the control group (33.86). This initial difference of approximately 12.75 points indicates that the two groups were not fully equivalent at baseline, which must be considered

when interpreting subsequent findings. The larger post-test improvement in the experimental group may reflect both the effect of the differentiated learning intervention and the pre-existing advantage in prior knowledge.

### Normality Test

The Kolmogorov–Smirnov normality test was conducted for the pre-test and post-test scores of both groups. Results are presented in Table 3.

**Table 3.** Kolmogorov–Smirnov normality test results

Group	Kolmogorov-Smirnov		
	Statistic	Df	Sig.
Score Pre-test of control class	0.114	35	0.200
Post-test of control class	0.130	35	0.144
Pre-test of experimental class	0.143	31	0.110
Post-test of experimental class	0.139	31	0.135

All significance values exceeded 0.05, indicating that the data from both groups were normally distributed. Specifically, the pre-test and post-test significance values for the control group

were 0.200 and 0.144, respectively, and for the experimental group 0.110 and 0.135. The normality assumption was thus satisfied for all four data sets.

**Overall Homogeneity Test**

An overall Levene’s homogeneity test was conducted across all four data sets (pre-test and

post-test scores of both groups) to examine general variance equality. Results are presented in Table 4.

**Table 4.** Overall homogeneity test results (all four groups)

Levene Statistic	df1	df2	Sig
2.485	3	128	0.064

The significance value of 0.064 exceeded the 0.05 threshold, indicating that the overall variance across all four data sets was homogeneous. This result confirmed the general equivalence of variance for the purpose of preliminary data

screening. However, as explained below, a separate homogeneity test was conducted specifically for the post-test scores between the two groups, which is the relevant assumption for the final hypothesis test.

**ANCOVA Results and Pre-test Covariate**

Analysis of Covariance (ANCOVA) was conducted with post-test scores as the dependent variable, class (experimental vs. control) as the independent variable, and pre-test scores as the

covariate. ANCOVA was included to examine whether the pre-test difference between the groups influenced the post-test comparison. Results are presented in Table 5.

**Table 5.** ANCOVA (tests of between-subjects effect)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8052.430 <sup>a</sup>	2	4026.215	28.877	.000	.478
Intercept	13212.871	1	13212.871	94.765	.000	.601
Pre-test (Covariate)	208.693	1	208.693	1.497	.226	.023
Class (Treatment)	4816.078	1	4816.078	34.542	.000	.354
Error	8783.934	63	139.428			
Total	250850.000	66				
Corrected Total	16836.364	65				

*R Squared = 0.478 (Adjusted R Squared = 0.462). Dependent Variable: Post-test.*

The ANCOVA results indicate that the pre-test covariate was not statistically significant (Sig. = 0.226 > 0.05, partial  $\eta^2 = 0.023$ ), suggesting that, when controlling for pre-test scores, the pre-test did not significantly adjust the post-test comparison between groups in this analysis. The class variable (treatment) was statistically significant (F = 34.542, Sig. = 0.000), with a partial  $\eta^2$  of 0.354, indicating

a large effect size. This means that approximately 35.4% of the variance in post-test scores was attributable to class membership (experimental vs. control). However, given the pre-test baseline difference between the groups (46.61 vs. 33.86) and the use of intact classes, these findings should be interpreted with caution. The significant ANCOVA result suggests an association between

differentiated instruction and higher post-test scores, but it does not eliminate the possibility that

the pre-existing difference in prior knowledge contributed to the outcome.

**Post-test Homogeneity Test**

A separate Levene’s homogeneity test was conducted specifically for the post-test scores of the experimental and control groups to determine

whether the independent sample t-test or a non-parametric alternative was appropriate. Results are presented in Table 6.

**Table 6.** Post-test homogeneity test results

<i>Levene Statistic</i>	<i>df1</i>	<i>df2</i>	<i>Sig</i>
6.673	1	64	0.012

The significance value of 0.012 was below 0.05, indicating that the post-test variance between the two groups was not homogeneous. Because the independent sample t-test requires both normality

and homogeneity of variance (Kadir, 2015), this assumption violation necessitated the use of a non-parametric alternative. Consequently, the Mann–Whitney test was used for the final hypothesis test.

**Mann–Whitney Test**

The Mann–Whitney test was used to compare post-test scores between the experimental

and control groups. Results are presented in Table 7.

**Table 7.** Mann–Whitney test results

	<b>Post-test</b>
Mann-Whitney U	83.500
Wilcoxon W	611.500
Z	-5.701
Asymp. Sig. (2-tailed)	0.000

The Mann–Whitney test revealed a statistically significant difference between the post-test scores of the experimental and control groups (Asymp. Sig. = 0.000 < 0.05). The null hypothesis was therefore rejected, and the alternative hypothesis was accepted. These results indicate that there was a significant difference in learning outcomes between students who received differentiated learning instruction and those who received conventional instruction.

significant at both the ANCOVA level (with a large effect size of partial  $\eta^2 = 0.354$ ) and the Mann–Whitney level (Sig. = 0.000).

It should be noted, however, that because the experimental group had a higher pre-test mean at baseline, the Mann–Whitney result alone does not establish that the differentiated learning intervention was the sole cause of the post-test difference. Statistical significance reflects a real difference in post-test outcomes, but the initial group inequality must be acknowledged as a limitation.

The implementation of differentiated learning in this study was organized around three components: content differentiation, process differentiation, and product differentiation. Each component addressed the varied learning profiles of students in the experimental class. In terms of content differentiation, instructional materials were provided in different formats aligned with students’ learning profiles: visual learners received reading materials featuring labeled organ diagrams and written explanations of the respiratory process; audio-visual learners received barcodes linking to video materials explaining respiratory mechanisms; and kinesthetic learners received both video materials and guided physical activities, such as exhaling on a mirror surface to observe condensation. This variety of representations created multiple access points for students to engage with abstract concepts such as gas exchange, making the material more accessible to diverse learners.

**Discussion**

The findings of this study suggest that differentiated learning strategies were associated with higher post-test learning outcomes in the human respiratory system topic. The experimental group’s mean post-test score (71.13) was substantially higher than that of the control group (49.29), and this difference was statistically

In terms of process differentiation, activities were designed to match students’ preferred modes of engagement. Visual learners were asked to observe and label organ diagrams and explain the

function of each respiratory organ. Audio-visual learners completed crossword puzzles while watching video materials, integrating listening and vocabulary tasks. Kinesthetic learners constructed simple teaching aids that modeled respiratory structures based on provided materials. These varied tasks encouraged active engagement with content and supported deeper conceptual understanding, which may explain why students in the experimental group showed greater improvement from pre-test to post-test.

Product differentiation was implemented by allowing students to present their learning in ways suited to their learning profiles, including written explanations, visual summaries, and physical demonstrations. This approach acknowledged that students demonstrate knowledge differently and valued multiple forms of academic output.

These findings are consistent with earlier studies. Suwartiningsih (2021) demonstrated that differentiated instruction effectively improved science learning outcomes across multiple phases of classroom action research. Bilantua et al. (2024) found that differentiated instruction had a positive impact on student achievement in Integrated Social Studies at SMPN 1 Tomilito, with a significance value of  $0.038 < 0.05$ . Similarly, Sitorus et al. (2022) reported a significance value of  $0.032 < 0.05$  and a 12.58% increase in student outcomes when differentiated learning was applied. At the international level, Lee and Cho's (2023) meta-analysis confirmed that differentiated instruction significantly improves learning outcomes across educational levels, and Pham and Renshaw (2022) found that adaptive teaching practices are particularly effective in culturally diverse classrooms.

It is important to note that while this study organized differentiation based on students' learning style profiles, the primary mechanism of benefit is likely the provision of varied instructional representations, tasks, and products, rather than the matching of instruction to learning styles per se. The concept of learning styles as fixed, discrete categories is debated in the educational research literature. A stronger interpretation of the current findings is that offering multiple means of engagement and representation created broader access to the material for students with different learning backgrounds and preferences, which is consistent with the principles of Universal Design for Learning.

The active role of teachers also contributed to the learning environment. Teachers who are able to respond to individual student needs and build intrinsic motivation can significantly improve learning outcomes (Hattie & Timperley, 2019). The attention given to each student's profile in the

experimental class may have increased student engagement and interest, which are known to be positively associated with learning achievement (Harackiewicz et al., 2016).

Despite these positive findings, several limitations should be acknowledged. First, the use of intact classes without random assignment means that pre-existing differences between the groups could not be fully controlled. The experimental group entered the study with a notably higher pre-test mean (46.61 vs. 33.86). Although ANCOVA did not find the pre-test covariate to be a statistically significant predictor of post-test scores in this analysis, the baseline difference remains a substantive concern. Future research should aim for more equivalent groups at baseline, or should calculate and compare normalized gain scores to better isolate the effect of the intervention. Second, the study was conducted over a limited period at a single school, which limits generalizability. Third, the instrument validity and reliability results should be reported in greater detail in future publications.

The mapping of differentiated learning strategies in this experimental class was carried out based on learning profiles through students' learning styles. Learning style is the way students manage information or knowledge gained (Matussolikhah & Rosy, 2021). Before planning a differentiated learning strategy, researchers gave students a learning style questionnaire. The findings derived from the learning approach survey revealed three distinct categories of learning approaches, specifically: visual learning preference, audio-visual learning preference, and kinesthetic learning preference. Visual learning preference represents an educational method that emphasizes visual perception, observation, or view, such as looking at pictures, diagrams, or notes. Audio-visual learning preference represents an educational approach that emphasizes auditory perception, such as viewing multimedia content. Kinesthetic learning style is a learning method that focuses on movement and practice, such as practicum (Hasanah, 2021).

This differentiated learning strategy is carried out with the aim of overcoming the problems that occur at SMPN 9 Banjarmasin based on researcher observations during the Teaching Assistance activities during the second semester of the 2024/2025 academic year. The problem that occurs is low student learning outcomes caused by suboptimal learning. There are three factors that cause suboptimal learning, namely: first, students' learning styles are diverse but teachers are less varied in conducting learning in class, learning tends to use the lecture method, this certainly cannot facilitate the instructional process for each learner with varying learning preferences; second,

the educational activity procedure that places the teacher as the main facilitator can reduce more dynamic interactions between teachers and students; third, based on existing problems, students think that science subjects are difficult and boring so that their interest in learning is lacking, this greatly affects their learning outcomes.

Reviewing the problems, the execution of differentiated instructional approaches is conducted encompassing three components, specifically content variation, process variation, and product variation. The implementation of differentiated instructional approaches enhances the effectiveness of the educational process, resulting in improved academic performance among students. Based on these results, it is evident that the application of differentiated instructional approaches produces a substantial impact on academic performance. This can happen because differentiated learning has been in alignment with the diverse needs of students, especially in terms of learning styles. Differentiation is carried out incorporating three components, specifically: content variation, process variation, and product variation.

Differentiation of content at the first meeting was done by differentiating the delivery format of the human respiratory system material given to students with three different types of learning preferences, specifically: visual, audio-visual, and kinesthetic. Learners with a visual learning approach, the content delivery format is given through instructional materials featuring diagrams of human respiratory system organs and breathing processes dissertations with verbal explanations through written sentences. Reading materials for visual learning styles is presented in figure 1.

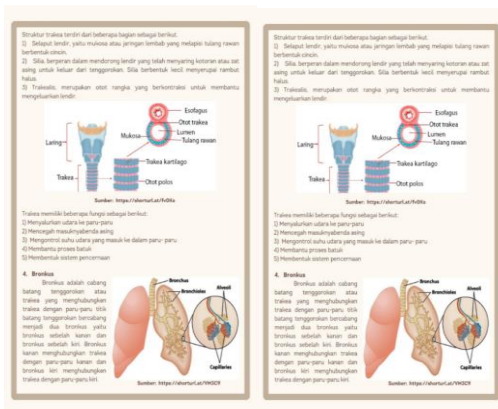


Figure 1. Differentiation of visual learning style content

Learners with audio-visual learning preferences, the format of delivering the material is given by providing a barcode containing a video of

learning material on the human respiratory system. Students watch the video by scanning the barcode first. The following is a picture of the barcode and a picture from the video clip, is presented in figure 2.



Figure 2. Differentiation of audio-visual learning style content

Students with kinesthetic learning styles, the format of delivering the material is given by providing a barcode containing a video of learning material on the human respiratory system. In addition, students also imitate the movements in the video by exhaling on the mirror surface to find out what happens. Here is a picture of the barcode and a picture from the video clip, is presented in figure 3.



Figure 3. Differentiation of kinesthetic learning style content

Differentiation of the process at the first meeting was conducted by differentiating the process performed by learners to practice and understand the material on the human respiratory system according to learning preferences. Learners with a visual learning approach were given the task of observing pictures of organs in the respiratory system and explaining the function of each organ. The following is a description of the task given is presented in figure 4.

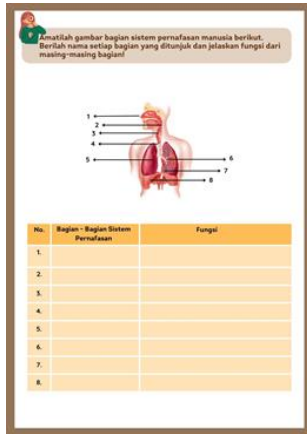


Figure 4. Differentiation of visual learning style processes

Students with audio-visual learning styles are given the task of answering crossword puzzles by listening to explanations in learning videos. Here is an overview of the tasks given, is presented in figure 5.



Figure 5. Differentiation of audio-visual learning style processes

Learners with a kinesthetic learning preference are given the task of making teaching aids based on the text provided in the image below, is presented in figure 6.



Figure 6. Differentiation of kinesthetic learning style processes

Product differentiation at the first meeting was done by presenting the assignments that had been given according to learning styles. Students with visual, audio-visual, and kinesthetic learning styles presented the results of their assignments, here is the documentation, can be seen in the figure 7.



Figure 7. Differentiation of visual, audio-visual, and kinesthetic learning style products

The execution of differentiated instructional approaches through implementing three components of content variation, process, and product corresponding to learners' learning styles was also carried out at the second meeting. Based on this implementation, it is evident that comprehending learners' learning preferences can assist in addressing students' educational requirements more efficiently. The findings of research conducted by Jamali (2017) in Malaysia, showed that knowing students' preferred learning styles will assist educators in establishing a learning environment that accommodates learners' requirements, enabling their scholastic performance to be enhanced more effectively (Jamali & Mohamad, 2017). The results of this research show that students whose learning styles

are dominant when taking tests will achieve much higher scores than those who learn not in line with their learning styles.

Student learning outcomes are also related to their learning interests, this has been proven in various studies showing that students with high interest in a subject tend to have better learning outcomes than those who are less interested (Harackiewicz et al., 2016). In addition, the active role of teachers is also important. Teachers not only teach but also motivate students to be more enthusiastic in learning, direct them in comprehending the content, and establish an educational environment that supports the academic and character development of students.

Teachers who are able to build intrinsic motivation in students can significantly improve learning outcomes (Hattie, 2021). Therefore, it can be determined that when the instructional process can address learners' requirements, academic performance will improve accordingly. This investigation demonstrates that there is an impact of implementing differentiated instructional approaches on the learning outcomes of grade VIII students in the human respiratory system material. This study also recommends learning differentiation that teachers can do, in accordance with the empirical findings in this study. This finding supports Pham and Renshaw's (2022) argument that adaptive teaching practices are particularly effective in culturally diverse classrooms, enhancing inclusivity and academic gains. The results are consistent with Lee and Cho's (2023) meta-analysis, which confirmed that differentiated instruction significantly improves students' learning outcomes across various educational levels.

## CONCLUSION AND SUGGESTION

### Conclusion

Based on the findings of this study, it can be concluded that differentiated learning strategies were associated with significantly higher post-test learning outcomes in the human respiratory system topic among Grade VIII students at SMPN 9 Banjarmasin. This was evidenced by the Mann-Whitney test result (Asymp. Sig. = 0.000 < 0.05) and the ANCOVA treatment effect (partial  $\eta^2$  = 0.354, indicating a large effect size). The experimental group, which received differentiated instruction based on content, process, and product differentiation, achieved a higher post-test mean (71.13) compared to the control group (49.29). However, the initial pre-test difference between the groups (46.61 vs. 33.86) should be considered a limitation when interpreting these results. The findings suggest that differentiated instruction may support diverse learners in achieving better

learning outcomes in science, but further research with more equivalent baseline groups is recommended.

### Suggestion

Based on the research findings, the following recommendations are offered. First, students are encouraged to identify their own learning preferences and actively seek materials suited to their learning styles, rather than depending solely on teacher-delivered instruction. Second, teachers are encouraged to recognize students' diverse learning needs and implement more varied instructional strategies, including differentiated instruction, to create inclusive and effective learning environments. Third, future researchers are encouraged to address the limitations of this study by using more equivalent groups at baseline, calculating normalized gain scores, and reporting detailed instrument validity and reliability data. Researchers should also explore differentiation based not only on learning style profiles but also on students' cognitive readiness levels and learning interests.

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