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The effect of make-a-match learning assisted by animation media on students' higher-order thinking skills of human respiratory system material

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Abstract: This research aims to determine the effect of the make-a-match learning model assisted by animation media on students' high-level thinking abilities on the human respiratory system material. This research was conducted from October 2023 to June 2024 at SMAN 18 Medan using a quasi-experimental method with a two group pretest-posttest design. The sampling technique uses cluster random sampling. The experimental class XI MIA2 has 35 students and the control class XI MIA3 has 36 students. The research instrument used was the HOTs test in the form of multiple choices. The results showed that the average score for the experimental class was 82.40, while the average score for the control class was 69.33. Students who were taught using the make-a-match model assisted by animation media had higher average scores compared to students who were taught using the direct instruction learning model. Hypothesis testing with t-test statistics shows a significance value (2-tailed) of 0.000 < 0.05. This shows that the make-a-match learning model assisted by animation media has a significant effect on students' HOTs in the human respiratory system material at SMAN 18 Medan.

Keywords: Make-a-match learning, animation media, HOTs, human respiratory system

Abstrak: Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran make-a-match berbantuan media animasi terhadap kemampuan berpikir tingkat tinggi siswa pada materi sistem pernapasan manusia. Penelitian ini dilakukan pada bulan Oktober 2023 sampai Juni 2024 di SMAN 18 Medan menggunakan metode quasi eksperiment dengan desain two group pretes-postes. Teknik pengambilan sampel dengan menggunakan cluster random sampling. Kelas eksperimen XI MIA2 berjumlah 35 siswa dan kelas kontrol XI MIA3 berjumlah 36 siswa. Instrumen penelitian yang digunakan adalah tes HOTs berbentuk pilihan berganda. Hasil penelitian menunjukkan bahwa nilai rata-rata kelas eksperimen adalah 82,40, sementara nilai rata-rata kelas kontrol adalah 69,33. Siswa yang diajarkan dengan model make-a-match berbantuan media animasi memiliki nilai rata-rata yang lebih tinggi dibandingkan dengan siswa yang diajarkan dengan model pembelajaran direct instruction. Pengujian hipotesis dengan statistik uji-t menunjukkan nilai signifikansi (2-tailed) sebesar 0,000 < 0,05. Hal ini menunjukkan bahwa model pembelajaran make-a-match berbantuan media animasi berpengaruh secara signifikan terhadap HOTs siswa pada materi sistem pernapasan manusia di SMAN 18 Medan.

Kata kunci: Pembelajaran make-a-match, media animasi, HOTs, sistem pernapasan manusia

INTRODUCTION

Higher-order thinking skills (HOTs) are the skills that students must master in order to meet the demands of 21st-century learning (Kalelioglu & Gulbahar, 2023). The main aim of HOTs is to improve students' ability to think critically in receiving various types of

information and making decisions in complex situations (Sani, 2019). HOTs are increasingly needed at this time because this way of thinking can be applied to solve problems in real life. Students will encounter many problems in their daily lives, therefore HOTs are needed to overcome these problems (Hasruddin et al., 2016).

Indicators for measuring HOTs based on the revised Bloom's Taxonomy include: (C4) Analyzing, namely, students can solve a problem, make decisions, and conduct scientific research; (C5) Evaluating, namely students can create solution strategies and solve problems by being able to evaluate the problems in the problem; and (C6) Creating, which refers to students' ability to find solutions when facing problems (Dwi et al., 2020). Analyzing skills (C4) are essential in the learning process, especially in biology studies. According to Anggraini and Sriyati (2019), questions at the C4 level require students to be able to analyze data or information so that they can answer a problem. Analytical skills help students understand and convey learning materials well, collaborate on group assignments, and think critically about theories and concepts.

Evaluating skills (C5) are also very necessary. According to Dewi et al. (2020), questions at the C5 level ask students to be able to create a solution strategy and solve problems by being able to evaluate problems in the questions and being able to check and assess knowledge. Creating skills (C6) is the last indicator at the taxonomy level, this indicator is very necessary for the learning process because creative skills can design problem-solving steps and produce an idea for a solution to the problem. This is in line with the opinion of Dewi et al. (2020) that questions at the C6 level refer to students' ability to find solutions when facing problems.

Questions containing HOTs can improve students' critical thinking skills. Using HOTs questions can hone students' abilities and skills even better because by working on these questions students will be skilled in solving various problems at a higher level (Widana, 2017). Therefore, students must be trained to work on questions at levels C4, C5, and C6. However, not only that but HOTs can also be given through stimuli that can be sourced from current global issues (Supriadi et al., 2016). HOTs are necessary for the biology learning process because biology lessons as part of science are not only limited to students' activities in recording and memorizing material but also understanding the material well (Ulfah et al., 2023). One of the biology subject materials is the human respiratory system. This material requires understanding and thinking skills to understand the mechanisms of breathing in humans (Utami et al., 2018).

To create an interesting learning process in biology subjects, teachers must have appropriate teaching strategies because they play a crucial role in developing students' intelligence and thinking abilities, so one effort that can be made is to design learning models that are interesting, effective, and fun (Pambudi, et al., (2022); Rivalina, 2020). This is one of the aspects of learning that is a guideline for carrying out activity steps. In order to enhance learning attitudes, learning motivation, critical thinking abilities, and the attainment of

learning outcomes, educators implement learning models (Murti et al., 2024; Novitasari et al., 2024; Sundari, 2015). There are various learning models, one of which is the make-a-match learning model (Munir et al., 2018). According to Utomo et al. (2018), this model engages students in finding pairs of cards that are related, with each card featuring interconnected questions and answers.

The syntax of the make-a-match learning model is: 1) Presenting information, 2) Organizing, 3) Make-a-match game, 4) Presentation, and 5) Evaluating (Suprijono, 2009). Learning with this model has advantages, namely interaction with peers and having a sense of responsibility for the choices of answer pairs or questions in playing games (Sinaga et al., 2018). The advantage of this model is that it can boost learning motivation by enabling students to interact with their peers, turning the classroom into a competitive game where groups work together to solve subject-related problems (Fidiyanti et al., 2017). The statement is relevant to the research findings by Lolonga et al. (2016) that the implementation of this learning model can enhance students' critical thinking skills.

This learning model has the potential to enhance the interaction of all components of learning, including teachers, students, senses, and intentions, thereby rendering the learning process more meaningful (Khakim et al, 2019). Learning becomes more meaningful when it takes place in an environment that offers strong support for the learning process (Nurhasanah et al., 2022). Meaningful learning will be an extraordinary learning experience to gain knowledge and improve thinking skills.

Based on interviews conducted with biology teachers in class, the average student still has low-level thinking abilities few students have high-level thinking abilities. This is evidenced by the many students who have low grades when given HOTs questions and the passive nature of the learning process observed by the researcher. This issue arises from the implementation of a direct instruction model that is teacher-centered, resulting in a lack of student engagement and insufficient development of their thinking skills, especially HOTs. Therefore, an effort that can be made is to use a different learning model. Not all material in biology learning is concrete and easy to observe, so it requires the help of learning media. Learning media is a crucial element of the educational process, as students are unlikely to achieve optimal outcomes without it (Sagala & Andriani, 2019). To achieve optimal results, it is certainly necessary to have learning materials as a means to help understand the subject matter.

Visualization of the human respiratory system is needed to understand material that cannot be seen, such as the respiratory process and the organs that work. Thus, learning media based on animated videos is essential to support and enhance the learning process. Animation media is a learning medium that can produce real effects from inanimate images by displaying audio-visual forms with moving images and sound (Hariati et al., 2020). Animation media is seen as enjoyable and helps students understand the lesson material through visually engaging presentations (Sukariasih et al., 2020).

This animated media can be created using video editing applications, one of which is the kinemaster application. Kinemaster is a video editing application that can be downloaded for free by anyone. This application has many advantages, including having features that are easy for beginners to use, this application is highly recommended for creating animated media (Wastiami & Mudinillah, 2022). Based on research conducted by Anggriani (2019) animation media can improve students' HOTs. Thus, by the background of the problem that has been outlined, this research aims to determine the effect of the make-a-match learning model assisted by animation media on students' HOTs in the human respiratory system material at SMA Negeri 18 Medan.

METHOD

This research was conducted at SMAN 18 Medan which is located at Wahidin Street Number 55 C, Pandau Hulu I Village, Medan City District. This research was carried out from October 2023 to June 2024. The population in this research was all class sampling using the Cluster Sampling technique. Class XI MIA_2 was obtained as an experimental class taught using the make-a-match model assisted by animation media, and XI MIA_3 as a control class taught using the direct instruction model.

Quasi-experimental research is implemented. A two-group pretest-posttest design was implemented. Data collection was carried out by giving tests for HOTs using multiple-choice questions which included indicators of analyzing, evaluating, and creating.

The validity of the HOTs test instrument was evaluated using statistical analysis with SPSS version 27.0 software. To assess validity, a significance test was conducted by comparing the r_{count} value to the r_{table} value at a significance level (α) of 0.05, if $r_{count} > r_{table}$, then the question item is said to be valid and vice versa. R_{table} value = 0.404. The results of the question items' validity are as follows.

Table 1. Validity Results of Question Items

Items	r_{count}	Validity	Items	r_{count}	Validity	Items	r_{count}	Validity
1	0.632	√	15	0.419	√	29	0.432	√
2	0.461	√	16	0.444	√	30	0.408	√
3	0.438	√	17	0.522	√	31	0.468	√
4	0.652	√	18	0.436	√	32	0.517	√
5	0.618	√	19	0.451	√	33	0.476	√
6	0.458	√	20	0.430	√	34	0.471	√
7	0.454	√	21	0.509	√	35	0.438	√
8	0.578	√	22	0.522	√	36	0.446	√
9	0.340	X	23	0.402	X	37	- 0.120	X
10	0.373	X	24	0.388	X	38	0.469	√
11	0.422	√	25	0.558	√	39	0.512	√
12	0.604	√	26	0.502	√	40	0.420	√
13	0.372	X	27	0.442	√			
14	0.471	√	28	0.486	√			

Note: V= Valid, X= Invalid

Table 2. The Results of the Reliability Test

Cronbach's Alpha	N of Items
0.901	40

The reliability test results used in the learning trial test data obtained a value of 0.901, which indicates reliability in the very high category.

Data analysis involved using a t-test, which requires preliminary tests for normality and homogeneity. The normality of the data was assessed through the Shapiro-Wilk test, conducted with SPSS software version 27.0. If the results testing obtained mark significance bigger than 0.05, then the data is declared normal and on the contrary. Test homogeneity is done to know that sample data originate from a homogeneous population. If results testing homogeneity get a mark significance bigger than 0.05 then the data is stated homogeneous and on the contrary. After doing the test prerequisite, test the hypothesis with the use independent sample t-test. Retrieval decision based on level significance 0.05. H_a (yes influence) is accepted if the mark significance < 0.05 And on the contrary.

RESULTS AND DISCUSSION

The data collected from the study consists of the pre-test and post-test results. Tests used are multiple-choice questions that cover the indicator analyzing, evaluating, and creating. Process learning in class experimental using a learning model make-a-match with animation media assistance kinemaster in convey material learning whereas on class control using a learning model direct instruction with power-point media assistance in convey material learning. Pre-test and post-test data for both classes can be found in Table 3.

Table 3. Pre-Test and Post-Test of Students in the Experimental and Control Classes

	Pre-test		**Post-test**	
	Experimental	**Control**	**Experimental**	**Control**
N	35	36	35	36
Max	64.00	68.00	96	88
Min	20.00	20.00	64	48
$\bar{x}$	40.06	39.56	82.40	69.33
SD	10.89	10.42	7.40	10.02
Normality Test				
df.	35	36	35	36
Sig.	0.134	0.081	0.262	0.141
Homogeneity Test				
df1	1		1	
df2	69		69	
Sig.	0.253		0.093	
T-Test				
df	69		69	
Sig.	0.861		0.000	

The mean score of the pre-test for the experimental class was 40.06 with a SD of 10.89, while the mean score for the control class was 39.56 with a SD of 10.42. After the

learning process, a post-test was conducted to assess the students' final abilities. The mean score of the post-test for the experimental class was 82.40 with a SD of 7.40, while the mean score for the control class was 69.33 with a SD of 10.02.

The normality test results indicated that the significance value for the pre-test was 0.134 for the experimental class and 0.081 for the control class. The significance values for the post-test were 0.262 for the experimental class and 0.141 for the control class. Since all significance values were greater than 0.05, it can be concluded that the data for both classes are normally distributed. The homogeneity test results showed a significance value of 0.253 for the pre-test and 0.093 for the post-test, suggesting that the data originated from homogeneous groups.

Hypothesis testing using the independent sample t-test showed that the pre-test value of sig. 0.861 which means H_a is rejected (no influence) while in the post-test the value is sig. 0.000 which means H_a is accepted (there is an influence). Based on a significance value of $0.000 < 0.05$, it can be decided that there is an influence of the make-a-match learning model assisted by animation media on students' HOTs in the human respiratory system material at SMAN 18 Medan.

The learning process begins with presenting the learning objectives and providing an overview and motivation for learning, after that delivering learning material using animation media related to the respiratory system in humans, after presenting the material then forming a study group consisting of 2 groups, namely question cardholder group and answer cardholder group. When the students have got each card, the students look for the right pair within the specified time, after the students get the answers, the students then convey the results of the answers they have got, and then the researcher evaluates the answers the students have got and appreciates their work. During the learning process with this model, students are actively engaged, are encouraged to collaborate in solving problems, and learn in an enjoyable environment.

When compared with the application of the direct instruction model, the make-a-match model is better to use. This is because when students are taught using the direct learning model they appear less active, and the teacher-centered approach does not train students to collaborate in discussions and problem-solving. In other words, the learning model used in the experimental class has a more positive impact. This finding aligns with research by Utari et al. (2021), which shows that the model effectively develops critical thinking skills.

This statement is backed by research by Alodia (2016), which demonstrates that this model is highly effective in fostering critical thinking skills among students. This model encourages students to think accurately and respond promptly, remembering that in its implementation students must be able to solve the answers within the specified time. Apart from that, this learning model helps students to understand concepts actively, creatively,

effectively, and interactively. So that concepts become easier to understand and persist in their cognitive structure (Wulandari et al., 2018).

Additionally, presenting the lesson material using animation media makes students more interested and enthusiastic because the animated media is made with an attractive appearance and is designed in detail to improve students' thinking abilities. This is consistent with research by Ridho et al. (2017) that the use of animation media has a positive impact on students' learning outcomes and critical thinking abilities. Animated media is crucial in education because it can help enhance students' motivation and enthusiasm for learning (Cahyani, 2020). Information that uses animation makes the information easier for students to understand, sometimes just reading makes the information difficult to understand.

Improving HOTs has become a priority in schools. Students must be trained to think at a high level according to their age. This can be done by teachers by providing HOTS-type test questions (Hamdi et al., 2018). For this reason, teachers are not enough to just take material from textbooks but need to provide more substantial material. This aims to enrich students' knowledge and be trained to work on questions at a higher level.

To address the needs of contemporary changes, advanced thinking skills are crucial in academic subjects. Future teachers with higher-order thinking skills are an important thing that teachers need. Teachers who have a strong understanding of HOTs will have significant changes in the way they teach students related materials to optimize higher-order thinking skills (Rahmi & Alberida, 2017). Therefore, teachers have an important role in guiding students to learn so that students become a great generation in the future.

CONCLUSION

This study concludes that the use of the make-a-match model assisted by animation media is effective in improving students' HOTs in the subject. This is evidenced by the increase in student learning outcomes and hypothesis testing that has been carried out. The findings of this study recommend that:

1. Biology teachers should use make-a-match as a variation in using learning models and utilize animation media when teaching.
2. Teachers should encourage and train students to work on HOTs questions to improve students' biology academic achievement.

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