
The Influence of the Science Technology Engineering and Mathematics Approach with Mind Maps on the Higher Order Thinking Skills (HOTS) of Students in Biology Learning Class X SMA N 4 Kerinci

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ABSTRACT

This study aims to determine the effect of the mindmap-assisted STEM approach on students' Higher Order Thinking Skills in learning biology class X SMA Negeri 4 Kerinci. This research is experimental research with a group pretest-posttest design model. The population in this study came from students of class X MIPA SMA Negeri 4 Kerinci in the academic year 2021/2022. The research sample was students of class X MIPA 2 and Class X MIPA 4. The sampling technique used was the random sampling technique. The data collection technique in this study was in the form of an objective test consisting of 20 HOTS questions that had been validated by experts. Data analysis is quantitative data analysis with tests using the SPSS 21 application. The results of the study can be concluded that the STEM approach has a significant effect on students' higher-order thinking skills in learning biology with the results of hypothesis testing $0.00 < 0.05$. Furthermore, the STEM approach can increase students' HOTS in biology learning, the average score of the experimental class students is 85.76 and the control class is 70.31.

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INTRODUCTION

The Industrial Revolution 4.0 has had a very important influence on the joints of life, especially in the field of education (Zulyusri et al., 2022). Education has become mandatory in nation building (Ahmad *et al.*, 2018). In addition, education also has the most important role in improving the quality of human resources (Akbar & Razak, 2019). Education at this time requires students to be able to master technology and learning skills (Mulyadi *et al.*, 2020). Today's students must have critical, creative, communicative and collaborative thinking skills (Puspitasari, 2020; Suryandari *et al.*, 2016; Eshet-alkalai & Geri, 2019). These skills will help them in solving various problems in the world of education (Sudarisman, 2015). Education has a very important role in facing future challenges (Ichsan *et al.*, 2020).

21st century learning is no longer centered on the teacher, but students must be more active (Ujir *et al.*, 2020). Students must be able to do learning using technology digital (Bennett, 2018). This can improve the quality of student learning in the classroom. In addition, students will be more effective and active in absorbing the information provided by the teacher (Cook *et al.*, 2016). The activeness of students in teaching and learning is very necessary to encourage the success of the learning process (Fradila et al., 2021).

The problems faced by Indonesia in the 21st century are the low level of education services, the low quality of education, the low quality of higher education and the lack of literacy of Indonesian students. (Widodo, 2015). One of the government's efforts to fix these problems is to improve the quality of learning. The quality of learning has a very important role to advance the nation. Learning that is very important at this time is learning science (Ferdyan et al., 2021). Science learning is one of the compulsory subjects in 21st century learning (ANugraha *et al.*, 2017). Therefore, teachers and schools are able to provide all the needs of students in supporting the learning process of science students (Anggriawan dkk., 2018). One part of science subjects is biology.

Biology is a unique science, especially in exploring living things that are around us (Shen *et al.*, 2018). Biology is basically in the form of facts, concepts, principles and theories that require understanding, analysis, synthesis, application, and evaluation or higher order thinking skills. Biology learning is learning that connects and understands nature systematically (Siti Ramdiah dkk., 2020). To understand this phenomenon, higher order thinking skills (HOTS) and scientific literacy are needed.

The results of observations and interviews with biology teachers at SMA N 4 Kerinci students still have high order thinking skills (HOTS) and scientific literacy are still in the low category. It can be seen that students still have difficulty answering complex questions, especially in biology material in

Table.2 Table.1 HOTS Value of Class X MIPA SMA N 4 Kerinci

No	Subject matter	HOTS value
1	Protista	70
2	Fungi (Jamur)	60
3	Monera	70

Source: Teacher observation, 2022

Table 2 shows the results of observations of higher order thinking skills (HOTS) in students, there are 3 materials that are still difficult for students to master or understand, namely protists, fungi (mushrooms) and monera. In the protista material, students were only able to score 70, in the fungi material (mushrooms) they scored 60, and in the monera material they scored 70. Not only that, in terms of scientific literacy, students were still in the low category and far from the Teaching Completeness Criteria, namely 75. In material protista scientific literacy students only get a score of 70, the material on fungi (mushrooms) gets an average score of 55, and the material on monera gets an average score of 75.

One of the efforts that can be done in overcoming this problem is to improve science learning in schools (Nofiana & Julianto, 2017). Efforts to improve the quality of learning in

schools by improving the quality of science learning for students and teachers. Learning in schools today students and teachers must be able to master science and technology (Razak dkk., 2021). In addition, it is necessary to adapt the approach used by the teacher. The Science, Technology, Engineering, and Mathematics (STEM) approach is a new approach that is able to solve problems related to the learning process (Santosa dkk., 2021; Merican *et al.*, 2017).

Previous research by Masban (2022) shows that the STEM approach has a positive influence on conceptual understanding and the ability to work with students in high school. Nugraha Research & Syafiah (2021) an approach based on STEM learning has an effect on students' higher order thinking skills. Research by Inayatullah et al, (2021) explained that STEM-based learning had a good impact on students' HOTS in science learning. Based on this, this study aims to determine the effect of the mindmap-assisted STEM approach on students' Higher Order Thinking Skills in biology class X SMA N 4 Kerinci.

RESEARCH METHODS

This research is an experimental research with a group pretest-posttest design model. The population in this study came from students of class X MIPA SMA Negeri 4 Kerinci in the academic year 2021/2022. The research sample was students of class X MIPA 2 as the experimental class and Class X MIPA 4 as the control class. The sampling technique used was random sampling technique. The data collection technique in this study was in the form of an objective test consisting of 20 HOTS questions that had been validated by experts. Data analysis is quantitative data analysis with tests using SPSS 21 application with sig value. < 0.05, then the hypothesis is accepted.

RESULT AND DISCUSSION

Result

The data obtained in this study is in the form of data related to Higher Order Thinking Skills (HOTS) or students' higher order thinking skills and scientific literacy. Data regarding Higher Oder Thinking Skills (HOTS) were obtained through objective tests in the form of multiple choices given to the experimental and control classes. Data from the Higher Order Thinking Skill (HOTS) research results can be seen in Table.2

Table 2. Average Higher Order Thinking Skill (HOTS) scores in both sample classes

Class	Mean	SD
Experiment	85,17	7,498
Control	71,33	9.091

Based on Table 2, it is known that the average value of Higher Order Thinking Skill (HOTS) or high-level thinking skills of students in the experimental class is 85.17 with a variance value of 56.219 and a standard deviation of 7.498. The average value of Higher Order Thinking Skill (HOTS) or high-order thinking skills of students in the control class is 71.33 with a variance of 82.644 and a standard deviation of 9.091. These results indicate that the average Higher Order Thinking Skill (HOTS) score of the experimental class students is higher than the Higher Order Thinking Skill (HOTS) score in the control class. Furthermore, the two sample classes are normally distributed and homogeneous can be seen in table 3.

Table.11 Normality and Homogeneity Test Results of Higher Order Thinking Skill (HOTS)

Paramater	Class		Keterangan
	Experiment	Control	
Normality	0,24	0,15	Normal
Homogeneity	0,11		Homogen

Based on Table. 3 the results of the Higher Order Thinking Skill (HOTS) data normality test in the experimental class with a significance value of 0.24 and the control class a significance value of 0.15 is greater than α 0.05, it can be concluded that both classes are normally distributed. In addition, Based on Table. 3. The results of the Higher Order Thinking Skill (HOTS) data homogeneity test were obtained from the students of the two study sample classes with a significance value of 0.11 greater than α of 0.05. Therefore, it can be concluded that both classes have homogeneous variations. Therefore, a hypothesis test was carried out to determine the effect of the mind map-assisted STEM approach on student HOTS in biology learning which can be seen in table 4.

Table 4. Test –T test

Distribusi Data	N	Mean	Std.Deviasi	Sig. (2-tailed)	Ket
Experiment Class	29	85,17	7.648	0.00	H ₁ is accepted
Control Class	30	71,33	9.248		

From the results of hypothesis testing in Table. 4 obtained a significance value of $0.00 < 0.05$, which means that there is a significant effect on the value of Higher Order Thinking Skill (HOTS) and students' scientific literacy between the experimental class and the control class. This shows that H₀ is rejected and H₁ is accepted, so it can be concluded that the use of the Science, Technology, Engineering and Mathematical (STEM) approach with the help of Mind maps has an effect on Higher Order Thinking Skills (HOTS) or students' high-level abilities and student literacy in biology learning.

Discussion

Based on the analysis of data related to students' Higher Order Thinking Skills (HOTS) in the material on functions, it shows that the two sample classes have different average values. The experimental class has an average value of 85.17, while the control class has an average value of 71.33. According to (Bir *et al.*, 2021) learning Science, Technology, Engineering and Mathematics (STEM) is able to improve scientific process skills, life skills and engineering and design skills as well as students being able to solve various kinds of problems and make new discoveries and innovations. In addition, by applying the STEM approach students are able to develop 21st century skills, namely critical thinking, communication, collaboration and creativity and innovation (Seage & Turegun, 2020).

The mind map-assisted STEM approach is able to influence students' cognitive abilities, especially in students' higher-order thinking skills (HOTS). According to (A. W. Nugraha & Syafi, 2020) learning that applies the Science, Technology, Engineering and Mathematics (STEM) approach is able to improve students' cognitive abilities in learning. This is in line with research (Izzah *et.al.*, 2021) the Science, Technology, Engineering and Mathematics (STEM) approach is able to improve students' high-level thinking skills, especially in science learning.

Furthermore, the learning process that uses the Science, Technology, Engineering and Mathematics (STEM) approach assisted by a mind map is not only focused on developing critical, logical and systematic thinking skills, but also improving students' skills or future careers. This is in line with research (Hacioglu & Gulhan, 2021) the STEM approach is able to develop students' critical thinking skills and indirectly have an impact on developing student careers in the future (Santosa & Razak, 2021). In addition, learning with the Science, Technology, Engineering and Mathematics (STEM) approach assisted by mind maps can improve student learning outcomes. This is in line with opinion (Redhana *et al.*, 2021) learning that uses mind maps or mind maps has better learning outcomes than other learning.

CONCLUSION

Based on the research above, it can be concluded that the STEM approach has a significant influence on students' higher order thinking skills in biology learning with a hypothesis test result of $0.00 < 0.05$. Furthermore, the STEM approach can increase students' HOTS in learning biology, the average score of students in the experimental class is 85.17 and the control class is 71.33.

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