THE INFLUENCE OF SCIENCE TECHNOLOGY AND SOCIETY (STS) LEARNING MODELS ASISSTED WITH ANIMATED VIDEO ON CRITICAL THINKING ABILITY STUDENTS STATIC FLUID MATERIAL AT SMP 27 MEDAN

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Abstract

This research aims to find out whether abilities have increased students' critical thinking through the Science Technology Society (STS) learning model assisted by video animation on static fluid material meets the high and high criteria What aspects of critical thinking are developed through the Science Technology Society (STS) learning model assisted by animated videos on static fluid material This type of research uses the Quasi Experimental Design method with design Two group pretest-posttest design research. The sample in this study consisted of two classes, namely the experimental class and the control class. The experimental class consisted of 32 students, namely class VIII-2 and the control class consisted of 32 students from SMP Negeri 27 Medan who were selected using purposive sampling. The instrument used is a critical thinking ability test which has been validated in the form of an essay (description) with 8 questions and meets the content validation requirements, namely 0.368 to 0.645 which is classified as validity content is of the valid type and meets the reliability requirements of 0.563 which is classified as reliability. From the research results obtained from the experimental class, the average pretest was 25.81 and posttest was 78.75, meanwhile control class, the average pretest 24.50 and posttest was 59.00 which stated that the data was homogeneous. On normality test the Kolmogorov Smirnov test pretest value was obtained (0.052) and posttest (0.067) which stated that the data was normally distributed Based on the results of test analysis hypothesis (independent sample t test) was obtained that sig2 tailed < 0.05, namely 0.000 < 0.05, which means that the Ha hypothesis test results were accepted, indicated by the presence of a significant influence. On Normalized gain testing obtained an n-gain of (71.00%) which states that students' critical thinking skills are taught using the Science Technology Society (STS) learning model assisted by animated videos on static fluid material meet the moderate criteria (Fair). Research result shows that students' critical thinking abilities for aspects (indicators), namely indicator 1 Basic Clarification (simple explanation) is 80.00%, indicator 2 Basic Support is 76.00%, indicator 3 Inference (drawing conclusions) is 71.00%, indicator 4 Further Clarification (Further explanation) was 66.00%, and the 5 Strategy and Tactics indicator was 60.00%. So, it can be concluded that the most developed aspect (indicator) of critical thinking is aspect (indicator) 1, Basic Clarification (simple explanation).

Keywords:
Science technology society,
Critical thinking,
Animation video,
Static fluid.

Pendahuluan

Education is a process of acquiring knowledge and skills that are useful in facing the era of globalization and the development of Science and Technology (IPTEK). Education has a significant impact on the development of society, because through regular education it can produce people who have the knowledge, behavior and skills to create society, nation and state. Based on Law no. 20 of 2003 concerning the National Education System states that education is a conscious and planned effort which aims to create a learning atmosphere and learning process so that students can actively develop their potential and have a

religious spirit, self-control, personality, intelligence, noble morals and good skills, for themselves (society) to realize the full potential of students in the learning process.

Science education plays an important role in improving the quality of education, especially in producing quality students, namely people who can think critically, creatively, and have positive attitudes towards science, society and take the initiative in responding to information in society caused by the impact of developments in science and technology. The Program for International Student Assessment (PISA) shows that Indonesia is ranked 74th out of 79 countries, with science ability showing an average score of 396, with an OECD average of 489 (OECD, 2018). These results indicate that Indonesia is a country that is classified as low in the science capability category. A good education system is expected to improve the quality of human resources. Therefore, to be able to participate in global competition, education must now focus on increasing the country's competitiveness. This can be achieved if school education is directed not solely at mastering and understanding scientific concepts, but also at strengthening students' problem-solving abilities and thinking skills, especially higher-level thinking skills, namely critical thinking skills (Riani et al., 2014)

Critical thinking ability means the ability a person needs to be able to deal with various conflicts that arise in social life as well as personally (Nuryanti et al., 2018). Facione (2011) explains that critical thinking is self-control, when determining something, it will provide explanation, analysis, judgment and reasoning, as well as using information, plans, methods, standards or background reviews which become the foundation for drawing conclusions for analysis. Teachers are obliged to make learning enjoyable, develop students' critical thinking abilities, find learning information independently, and actively create psychological structures in students (Patonah, 2014).

Based on the results of an interview with one of the science teachers at SMP Negeri 27 Medan, a problem was found that students experienced difficulties in learning science. This is caused by students' low understanding of concepts. Students' difficulties are also caused by a lack of development and involvement of students in their thinking skills where learning is still teacher-centered. Apart from that, the learning models used by teachers are also less varied. In the learning process carried out, teachers still use the conventional model, namely the conventional method. This is supported by initial test data on critical thinking ability with 15 questions, showing average that 9 of students completed it, while 22 of students did not complete it and had low critical thinking skills. One of the right ways to solve this problem is to change the old learning model with an innovative learning model and choose the right learning model.

Using the correct learning model is an alternative to overcome the problem of low student absorption capacity. So far, educators have not implemented a learning model that allows students to participate, and educators only use traditional learning models (Nurdyansyah & Fahyuni, 2016). Each learning model must be appropriate to achieve certain goals. Therefore, for different purposes, educators must use different presentation techniques to achieve their learning objectives.

Learning models are important things that teachers must pay attention to because learning models can influence student learning outcomes in teaching and learning activities. The learning model can be used as a pattern of choice, meaning that teachers can choose a learning model that is appropriate and efficient to achieve educational goals (Rehalat, 2016). One learning model that teachers can apply is the Science Technology Society (STS) model. The Science Technology Society (STS) develops cognitive, affective and psychomotor abilities that are formed in students, with the aim of being able to apply them in everyday life (Poedjiadi, 2007). The STS model invites students to think critically and act scientifically in responding to problems in society and to understand or understand how science, technology and their use are used for decision making (Wenno, 2008). Sujanem (2006) states that the STS learning model can increase activity, science and technology literacy and can create a climate that is conducive to learning, providing opportunities for students to be actively involved in learning.

Based on the research results of (Mungawanah et al,, 2018) he conducted research on the influence of the STS and CTL learning models on understanding physics concepts and critical thinking skills and obtained the average results of students' critical thinking skills in the medium category in the STS model, low category in the CTL model, and conventional. This is possible because learning towards critical thinking skills is not just obtained, but must be obtained through regular learning stages so as to build the habit of always being critical

in life. (Jamilah et al., 2018) have also conducted research on the influence of the Science Technology Society (STS) on the Critical Thinking Skills and Scientific Attitudes of junior high school students with the results that there were significant differences in critical thinking skills between groups of students who studied using the Model. STS with groups of students who learn using a direct learning model. Thus, students' critical thinking skills using the STS model are better than using the direct learning model.

Apart from using appropriate learning models, the use of learning media can also arouse students' desires, generate motivation and stimulate students to learn (Arsyad A, 2011). One of the media is video. Video can be used in the learning process, because it can provide unexpected experiences to students, by combining animation and pacing to demonstrate changes over time (Daryanto, 2016). Learning using animated videos is more successful in attracting students' attention because students are able to understand through 2 human sense sensors, namely through the eyes and ears. The use of animated videos is very helpful in the learning process and the delivery of learning material in an interesting way can increase students' understanding (Arimadona et al., 2022).

Based on the background above, the researcher is interested in conducting research with the title "The Influence of Science Technology and Society (STS) Learning Models Assisted with Animated Video on Critical Thinking Ability Students Static Fluid Material at SMP Negeri 27 MEDAN".

Bahan dan Metode

Tempat dan Waktu Penelitian.

This research was carried out at SMP Negeri 27 Medan, Medan City, North Sumatra Province, when this research was carried out in March 2024 even semester of the 2023/2024 Academic Year.

Hasil dan Pembahasan

Data Normality Test

Before testing the hypothesis, a test is first carried out The data prerequisite is the normality test. This normality test is carried out to find out whether the data used is normally distributed or not. Test calculation results normality of pretest and posttest students' critical thinking abilities (Appendix 19) using the Chi-Square Test with a significance level of 5% ($\alpha = 0.05$), with the Kolmogrov-Sminorv value criteria, it can be it was concluded that the data was not normally distributed, which can be seen in table 4.1

Table 4.1 Normality Test Results

Class	Kolmogrov-Sminorv			
	Pretest		Postest	
	Sig.	*Keterangan*	*Sig.*	*Keterangan*
Eksperiment	,052	Normally	,067	Normally
Control	,061	Normally	,063	Normally

Based on Table 4.1 above, it can be seen that the results of the data normality test pretest and posttest in the experimental class and control class. Sig value. for pretest in the experimental class it was .028 and the posttest was .047. Where are the test results normality of data in the experimental class pretest 0.052 > 0.05 and posttest data 0.067 > 0.05 so that the data in the pretest and posttest of the experimental class are distributed normal. Sig value. for the pretest in the control class it was .061 and the posttest was .061 ,063. Where the results of the data normality test in the control class pretest were

0.061 > 0.05 and posttest data 0.063 > 0.05 so that the data in the pretest and posttest of the control class normally distributed. Based on the normality test that has been tested with using SPSS it can be concluded that the pretest and posttest data are good the experimental class and control class are normally distributed, so next homogeneity test can be carried out.

Data Homogeneity Test

After the normality data is normally distributed, the test continues homogeneity, to see whether the data has homogeneous variance or not. In this study, the data homogeneity test used IBM SPSS statistics 21.0 for Windows with Levene's Test. By using a significance level of 5% It was found that the P value was> 0.05, so the data was homogeneous. As for the results of the analysis The pretest and posttest homogeneity tests can be seen in Table 4.2 below.

Table 4.2 Homogeneity Post-Test Results

	Levene Statistic	**df1**	**df2**	*Sig.*	**Description**
Postest	,186	1	62	,668	Homogen

Table 4.3 Homogeneity Pre-Test Results

	Value Interval	**Control Class**	**Experiment Class**	**Value Interval**	**Control Class**
Pretest	,148	1	62	,702	Homogen

Results of Pretest Data on Critical Thinking Ability

The critical thinking ability test is measured by giving a test of 8 questions in the form of an essay. The data from the initial test of critical thinking ability in the experimental class and the control class are presented in the Table 4.4.

Table 4.4 Pretest Data for Experimental Class and Control Class

Value Interval	Control Class	Experiment Class
	Frequency	Frequency
6-11	2	0
12-17	6	8
18-23	10	10
24-29	4	3
30-35	4	4
36-41	5	5
42-47	1	2
$\bar{x}$	25,81	24,47

Based on Table 4.4, the experimental and control classes obtained an average score of 25,81 and 24,47 in the critical thinking ability test is category low, respectively. The data shows that students have an initial ability that is not much different in critical thinking ability.

Results of Posttest Data on Critical Thinking Ability

The critical thinking ability test is measured by giving a test of 8 questions in the form of an essay. The data from the initial test of critical thinking ability in the experimental class and the control class are presented in the Table 4.5

Table 4.5 Posttest Data for Experimental Class

Value Interval	Experiment Class
	Frequency
59-62	1
63-66	1
67-70	3
71-74	2
75-78	6
79-82	10
83-86	5
87-90	4
$\bar{x}$	78,75

Table 4.6 Posttest Data for Control Class

Value Interval	Control Class
	Frequency
47-50	5
51-54	3
55-58	8
59-62	6
63-66	4
67-70	5
71-74	1
$\bar{x}$	59,00

Based on Table 4.5 & Table 4.6 the experimental and control classes obtained an average score of 78,75 category high and 59,00 category medium in the critical thinking ability test, respectively. The data shows that students have an initial ability that is much different in critical thinking ability.

Additionally, data shows an increase in the average score from pretest to posttest both classes. Thus, overall, it can be concluded that the experimental class experienced a greater increase in critical thinking abilities significant compared to the control class. These findings provide an indication It is strong that the learning model applied in the experimental class effective in improving students' abilities in critical thinking. In the experimental class, the application of the Science Technology Society learning model with the help of animated videos, this process encourage students to analyze and connect deep science concepts real life context to solve the problems faced, with guidance from the teacher. During this exploration, various factors influence students' critical thinking abilities. Students are encouraged to think critically throughout discussion, active in finding solutions, and digging up information from various sources literature to broaden their understanding. This model is not only helps students in solving problems, However, it is also encouraging them to apply the principles of science in everyday life, thus producing more complex and nuanced learning outcomes A complete recapitulation of pretest and posttest score calculations can be seen in attachment.

Results of Increasing Critical Thinking Ability (N-Gain)

Testing the N-gain of research data aims to measure how much students' understanding after being given learning. Students before studying With the existing learning model and media, a pretest of 8 essay questions (description) is first given to see the students' initial abilities. Then at the end of the meeting, students are given a posttest with the same questions determine the level of student

understanding. From the calculation results, it is obtained increased critical thinking skills (N-gain) experimental class by (.08%) meanwhile control class 28.57% briefly in Table 4.8

So it is concluded that the use of the social technology science (STS) learning model assisted by animated videos on static fluid material at SMPN 27 Medan is quite effective (medium)

Table 4.8. N-Gain Calculation Results

Class	Pretest	Postest	N	N-Gain	Descriptiom
Experiment	25,81	78,75	32	71,00%	High
Control	24,50	59,00	32	45,00%	Currently (Medium)

Based on the completed N-Gain, there is such a difference significant between the experimental group and the control group. In groups the N-Gain experiment was approximately 70,90% in the high category, whereas in the control group N-Gain was only around 45,00% by category currently (medium). This shows that the increase in critical thinking in the experimental class treated with the Science Technology Society learning model was much higher than the increase in literacy skills science control class who did not receive such treatment. Therefore, The N Gain results confirm that the application of the Science Technology Society learning model effectively improves critical thinking skills understand scientific concepts related to Static Fluid Materials.

Analysis of Aspects of Developed Critical Thinking Abilities

To find out aspects of developed critical thinking abilities From the class given the science technology society learning model assisted by animated videos, the gain value for each aspect used in the research was calculated (Appendix 23). Test results percentage gain in critical thinking skills from each indicator shown in table 4.9.

Table 4.9 Results of N-Gain of Critical Thinking Ability Experiment Class

No	Aspects (Indicator) of Critical Thinking Ability	Ability Gain Percentage Critical thinking	Category
1	Basic Clarification (simple explanation)	80%	High
2	Basic Support	76%	High
3	Inference (drawing conclusions)	71%	High
4	Further Clarification (Further explanation)	66%	Medium
5	Strategy and Tactics	60%	Medium

Table 4.10 Results of N-Gain of Pretest-Posttest Ability Experiment Class

Indicator	Pretest	Postest	Post-Pre	Score Ideal-Pre	N-Gain	N-Gain (%)
1	33,77	86,81	53,04	66,23	0,80	80
2	33,72	84,17	50,44	66,28	0,76	76
3	18,96	76,25	57,29	81,04	0,71	71
4	23,88	74,59	50,71	76,12	0,67	67
5	19,95	67,79	47,84	80,05	0,60	60

Based on table 4.8, it can be seen that the aspect of thinking ability students' critical thinking in classes given the Science Technology Society (STS) learning model, namely aspect 1 Basic Clarification (simple explanation) was 52,27%, aspect 2 Basic Support is 54,49%, aspect 3 Inference (drawing conclusions) was 58,55%, aspect 4 Further Clarification (Further explanation) was 69,31%, and aspect 5 Strategy and Tactics amounted to 65,82%.

Table 4.11 Results of N-Gain ofCritical Thinking Ability Control Class

No	Aspects (Indicator) of Critical Thinking Ability	Ability Gain Percentage Critical thinking	Category
1	Basic Clarification (simple explanation)	61%	Medium
2	Basic Support	53%	Medium
3	Inference (drawing conclusions)	36%	Low
4	Further Clarification (Further explanation)	39%	Low
5	Strategy and Tactics	40%	Low

Table 4.12 Results of N-Gain of Pretest-Posttest Ability Experiment Class

Indicator	Pretest	Postest	Post-Pre	Score Ideal-Pre	N-Gain	N-Gain (%)
1	28,73	71,85	43,13	71,27	0,61	61
2	33,49	68,70	35,21	66,51	0,53	53
3	17,29	47,08	29,79	82,71	0,36	36
4	21,91	52,38	30,47	78,09	0,39	39
5	18,75	50,96	32,21	81,25	0,40	40

Based on table 4.9, it can be seen that the aspect of thinking ability students' critical thinking in classes given the conventional learning model, namely aspect 1 Basic Clarification (simple explanation) was 60,51%, aspect 2 Basic Support is 52,94%, aspect 3 Inference (drawing conclusions) was 36,02%, aspect 4 Further Clarification (Further explanation) was 39,02%, and aspect 5 Strategy and Tactics amounted to 39,64%.

Discussion

This research was carried out using Science Technology Society (STS) Poedjiadi (2007) said that Science Technology Society (STS) means using technology as link between science and society so that students can understand what that has been studied. So, in learning using science and technology society that technology can be used as a link/application between science and the Science learning approach Technology Society (STS) according to Poedjiadi, namely: Science Technology Society learning model (STS) which links science and technology and benefits to society. Objective This learning is to shape the individual who have scientific and technological literacy as well have concern for community problems and environment. Science Technology Society (STS) seen as a learning process always in accordance with the context of experience man. In this model students are invited to increase creativity, scientific attitude, using deep scientific concepts and

processes everyday life.

In the STS model, static fluid learning begins by introducing problems or phenomena that are relevant in everyday life. For example, students can be invited to observe and analyze how ships float on water or how dams hold water. By seeing real applications of static fluid principles, students can better understand the importance of these concepts in their lives. Students are invited to explore how technology utilizes static fluid principles. For example, they can study the design and function of hydrometers, pressure measuring instruments, or the working principles of hydraulic brakes. By understanding the interaction between science and technology, students will become accustomed to thinking critically about how static fluid concepts are applied to solve technical problems, and also the STS Model emphasizes problem-based learning. Students are given assignments to solve problems involving static fluids, such as designing irrigation systems or solving cases of dam leaks. This process involves collecting data, analyzing information, and developing logical solutions, all of which encourage critical thinking ability. research conducted according to (Mushthofa et al., 2021) examines the application of the Science Technology Society (STS) to improve students' critical thinking abilities in cross-interest physics subjects where the ability to identify occupies, this highest criterion is due to learning in the experimental class there are more using media such as: cards of problems, videos, practical media and demonstrations so that students can more easily differentiate components that are one with the other other.

So to achieve this it can also be used as an additional tool to support the results of the STS, namely using animated videos. Animated videos are more suitable to be collaborated on the STS (Science, Technology, Society) model for static fluid material in junior high schools for several reasons such as Visualization of Abstract Concepts, like fluid static involves concepts that are often difficult to understand through text or static images alone. Animated videos can illustrate phenomena such as hydrostatic pressure, Pascal's law, and Archimedes' principle in a dynamic and interactive way, helping students understand these concepts better, then Real World Context, like animated videos can show real-world applications of static fluid principles, such as how dams, floating ships, or hydraulic systems work. By seeing how these concepts are applied in everyday situations, students can more easily understand the relevance and importance of the material being studied. and also Interactive and Interesting Learning, like animation makes learning more interesting and fun for students. Well-designed animations can attract students' attention and increase their engagement in learning.

When students are actively engaged, they are more likely to think critically about the material presented. Then, was carried out offline by starting with giving a pretest of 8 essay questions (descriptions) which had been tested on the validation class and were declared valid. The pretest is carried out before learning is carried out with the aim of finding out students' initial abilities and students' normal distribution. After carrying out the pretest, the researchers provided learning using a science technology society learning model assisted by animated videos. At the end of the meeting, students were given a posttest to see the final results of students' thinking abilities. From the results of the research carried out, the average N-gain value for the experimental class was 70,90%, while for the control class it was 45,00%. From the results of hypothesis testing using the independent sample t-test formula, the value of sig 2 tailed is 000, in other words sig 2 tailed < 0.05, so Ho is rejected and Ha is accepted. This means that the results of students' critical thinking abilities who are given learning using the science technology society model assisted by animated videos are greater than conventional learning that is determined. The use of media in the learning process is very important in efforts to improve students' critical thinking abilities. In this research, researchers used animated videos as learning media. Choosing animated videos can help students to see the problems given through videos, not just pictures, this aims to enable students to see and listen to problems, concepts and material simultaneously. This shows that the science technology society (STS) learning model assisted by animated videos can improve students' critical thinking abilities.

The results of calculating students' critical thinking abilities obtained a value (n-gain) of 70,90%. It can be seen that students' critical thinking abilities are categorized in the high category. Based on the gain percentage calculation, the high aspect of looking for similarities and differences is because students are able to work together in groups to respond to the discussion results of other groups who make presentations in front of the class. In carrying out group discussions, students are given student worksheets (LKPD) and

conduct group discussions. The use of LKPD in this case is that LKPD provides a structured framework for learning. This helps students understand the steps to follow in completing assignments or projects related to static fluids. In the STS model, where learning often involves investigating real-world problems, this structure is critical to maintaining focus and directing students through the learning process, like facilitating LKPD can be designed to present real world problems that require the application of static fluid concepts. Students are then asked to identify problems, collect data, analyze information, and develop solutions. In this way, LKPD encourages students to think critically and creatively in solving problems, then integrating Science, Technology and Society like LKPD can connect the concept of static fluids with technology and its impact on society. For example, students could be asked to evaluate the design of a dam or irrigation system, considering technical factors as well as social and environmental impacts. This helps students understand the complex interactions between science, technology, and society, which is at the heart of the STS model.

In the LKPD, students are given a problem regarding a phenomenon, then students carry out practicums in accordance with the concepts in the LKPD. After students and their groups hold discussions to conclude the results of the practicum, each group presents the results of the group discussion in front of the class. Then other groups can respond and provide feedback to the group making the presentation. Meanwhile, the aspect of analyzing opinions to see similarities and differences has a low percentage, indicated by several students experiencing misconceptions about static fluid material and its application in everyday life. In learning, teachers need to formulate criteria to decide which answers may be correct and give them repeatedly to create experience for students. Meanwhile, a low indicator for identifying an opinion or assumption indicates that students are still unable to explain the reasons for the relevant information to be used in solving the given problem, so students are not able to provide maximum results. By looking at the average results achieved from each indicator, it can be said that the science technology society (STS) learning model can improve students' low critical thinking abilities.

Closing

Conclusion

Based on the results of research and discussion, it can be concluded as follows:

1. There is an influence in students' critical thinking skills being taught using the Science Technology Society learning model (STS) assisted by animated videos on Static Fluid law material amounted to 70,90% which was obtained from the average results of the pretest and posttest and the results of the learning and LKPD given
2. Based on the percentage of each indicator (aspect) of critical thinking ability aspects students, the most developed aspect is aspect (indicator) 1 Basic Clarification (simple explanation) of 80,19%.

Suggestion

Based on the results and conclusions that have been explained previously, the researcher provides suggestions:

1. In several aspects (indicators) which are still relatively low in terms of results, they are aspects (indicators), namely Strategy and Tactics which is around 60,36% which needs to be increased further in the future
2. For teachers and prospective teachers, it is hoped that they can apply the model Science Technology Society (STS) video-assisted learning animation with an effort to improve students' critical thinking skills.
3. For future researchers, it is recommended to conduct research with materials or learning models with different media in an effort to improve student learning outcomes for the better

References

Acut, D., & Antonio, R. (2023). Effectiveness of Science-Technology-Society (STS) approach on students' learning outcomes in science education: Evidence from a meta-analysis. JOTSE, 13(3), 718-739.

Amilia, R., Wirahayu, Y. A., & Hartono, R. (2022). Pengaruh model pembelajaran Sains Teknologi Masyarakat (STM) berbantuan buku teks digital terhadap kemampuan berpikir kritis siswa. *Jurnal Integrasi Dan Harmoni Inovatif Ilmu-Ilmu Sosial (JIHI3S)*, 2(2), 104–115.

Amirshokoohi, A. (2016). Impact of STS issue oriented instruction on pre-service elementary teachers' views and perceptions of science, technology, and society. *International Journal of Environmental and Science Education*, 11(4), 359–387.

Arends, R.I. (2007). *Learning to Teach*. Newyork : McGraww Hill Comparies.

Arifin, Z. (2017). Kriteria Instrumen dalam Suatu Penelitian. *Jurnal THEOREMS (The Original Research of Mathematics), 2*(1):28–36.

Arikunto, S. (2016). Dasar-dasar Evaluasi Pendidikan. Jakarta: Bumi Aksara.

Arimadona, S., Silvina, R., Ramaza, F., Biologi, P., & Bukittinggi, S. A. (2022). Pengembangan Media Video Animasi Pembelajaran Biologi Berbasis Daring Materi Sistem Pencernaan Manusia Di Smp Negeri 2 Kecamatan Kapur Ix. *Journal on Teacher Education*, 3(2), 120–126.

Arsyad A. (2011). *Media Pembelajaran*. 23–35.

Arsyad, Azhar. (2013). *Media Pembelajaran*. Jakarta : PT.Raja Grafindo Persada.

Daryanto. (2016). *Daryanto. 2016. Media Pembelajaran (Peranannya Sangat Penting Dalamm Mencapai Tujuan Pembelajaran). Yogyakarta: Penerbit Gava Media*. 1–23.

De Bono, E. (2009). *Revolusi Berpikir*. Bandung : Mizan Media Utama

Dick, W., Carey, L., Carey, J, O. (2005). *The systematic design of instruction*

Eka, H. F., Oktaviana, D., & Haryadi, R. (2022). Pengembangan Media Pembelajaran Video Animasi Menggunakan Software Powtoon terhadap Kemampuan Berpikir Kritis pada Materi Sistem Persamaan Linier Dua Variabel. *JagoMIPA: Jurnal Pendidikan Matematika Dan IPA*, 2(1), 1–13.

Ennis, R. H. dkk (2005)

Jamilah, SadiaI W, & SumaK. (2018). Pengaruh Model Pembelajaran Sains Teknologi Masyarakat (STM) Terhadap Keterampilan Berpikir Kritis dan Sikap Ilmiah Siswa SMP. *Jurnal Pendidikan Dan Pembelajaran IPA Indonesia*, 8(2), 54–64.

Jenicek, M. (200). *A Physician's Self-Paced Guide to Critical Thinking*. Chicago : AMA Press.

Jennah, R. (2009). Media Pembelajaran. In *Media Pembelajaran*.

Kamil, P. M., Nuryadin, E., Setyawati, A., & Dewi, L. (2018). Pengaruh Model Pembelajaran Sains Teknologi Masyarakat Terhadap Keterampilan Berpikir Kritis Peserta Didik Pada Materi Archaebacteria Dan Eubacteria Serta Penerapannya Pada Usaha Mikro Kecil Menengah (Umkm) Masyarakat. *Bio Educatio*, 3(2), 279482.

Kurniawan, R. (2022). A Case Study Utilizing Podcasting for Educational Purposes in Online Teacher Education. Jurnal Muara Pendidikan, 7(2), 395-403.

Lilliasari. (2005). *Membangun Keterampilan Berpikir Manusia Indonesia melalui Pendidikan Sains* (Pidato Pengukuhan Guru Besar Tetap IPA). Bandung : UPI.

Miaz, Y. (2012). Penggunaan Pendekatan Sains Teknologi Masyarakat Untuk Meningkatkan Hasil Belajar Siswa Dalam Pembelajaran IPS Kelas IV SDN 01 Baringin Anam Baso Kabupaten Agam. *Universitas Negeri Padang*, 350, 1–53.

Miarso, Yusufhadi. (2011). *Menyemai Benih Teknologi Pendidikan*. Jakarta: Kencana Prenada Media Group.

Mulyanti, S., Halim, A., Ilyas, S., & Syukri, M. (2021, May). The impact of the science technology society (STS) approach on critical thinking ability and student learning outcomes. In Journal of Physics: Conference Series (Vol. 1882, No. 1, p. 012026). IOP Publishing..

Moon, J. (2008). *Critical Thinking in Exploration of Theory and Practice*. New York : Routledge.

Munandar, H., Sutrio, S., & Taufik, M. (2018). Pengaruh model pembelajaran berbasis masalah

berbantuan media animasi terhadap kemampuan berpikir kritis dan hasil belajar fisika siswa SMAN 5 Mataram tahun ajaran 2016/2017. *Jurnal Pendidikan Fisika dan Teknologi, 4*(1), 111-120.

Mungawanah, K., Supriyati, Y., & Marpaung, M. A. (2018, November). The influence of contextual learning model and critical thinking to science literacy of high school first year students. In Journal of Physics: Conference Series (Vol. 1108, No. 1, p. 012124). IOP Publishing.

Mushthofa, Z., Yulianti, D., Linuwih, S., Kunci Berpikir, K., Lintas, F., & Stm, M. (2021). Implementation of Science Technology and Society to Improve Student's Critical Thinking Ability in Cross-Interesting Physics. *Jpft, 9*(2), 116–121.

Ngalimun. (2016). *Strategi dan Model Pembelajaran*. Banjarmasin : Aswaja Pressindo.

Noprianda, M., Noor, M. F., & Zulfiani, Z. (2019). Keterampilan Berpikir Kritis Siswa Model Pembelajaran Problem Based Learning Dan Sains Teknologi Masyarakat Pada Konsep Virus. *Edusains, 8*(2), 182–191.

Nurdyansyah, & Fahyuni, E. F. (2016). Inovasi Model. In *Nizmania Learning Center*.

Nurohman, S. (2006). Hal Ini Menyebabkan Pembelajaran Menjadi Tidak Bermakna, Peserta Didik Tercerabut Dari Kehidupan Nyata, Dan Pada Akhirhya Pendidikan Tidak Mampu Memberikan Bekal. *Penerapan Pendekatan Sains-Teknologi-Masyarakat (STM) dalam Pembelajaran IPA Sebagai Upaya Peningkatan Life Skills Peserta Didik.*

Nuryanti, L., Zubaidah, S., & Diantoro, M. (2018). Analisis Kemampuan Berpikir Kritis Siswa SMP. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan, 3*(2), 155–158.

Patonah, S. (2014). Elemen bernalar tujuan pada pembelajaran ipa melalui pendekatan metakognitif siswa SMP. *Jurnal Pendidikan IPA Indonesia, 3*(2), 128–133.

Pedretti, E. (2003). Teaching science, technology, society and environment (STSE) education. Dalam Dana L. Zeidler (Ed.), *The role of moral reasoning on socioscientific issues and discourse in science education (pp. 219-239).* Dordrecht : Springer.

Poedjiadi, A. (2005). *Sains Teknologi Masyarakat Model Pembelajaran Kontekstual Bermuatan Nilai*. Bandung : PT. Rosdakarya

Poedjiadi, A. (2007). *Sains Teknologi Masyarakat Model Pembelajaran Kontekstual Bermuatan Nilai*. Bandung : PT. Rosdakarya

Poedjiadi, A. (2010). *Sains Teknologi Masyarakat Model Pembelajaran Kontekstual Bermuatan Nilai*. Remaja Rosdakarya : Bandung

Priadana, M. S., & Sunarsi, D. (2021). *Metode penelitian kuantitatif*. Pascal Books.

Primavera, I. R. C., & Suwarna, I. P. (2014). Pengaruh Media Audio-Visual (Video) Terhadap Hasil Belajar Siswa Kelas XI Pada Konsep Elastisitas. *Prosiding Seminar Nasional Pendidikan IPA FITK UIN Syarif Hidayatullah Jakarta, September*, 122–129.

Rehalat, A. (2016). Model Pembelajaran Pemrosesan Informasi. *Jurnal Pendidikan Ilmu Sosial, 23*(2), 1.

Riani, E. D., Sadia, I. W., & Jelantik, I. B. (2014). Pengaruh Model Pembelajaran Sains Teknologi Masyarakat (STM) Dalam Pembelajaran Biologi Bermuatan Karakter Terhadap Keterampilan Berpikir Kritis dan Kemampuan Pemecahan Masalah Siswa SMA. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha, 4*(3).

Rosmawati, E., Kania, N., & Nurhikmayati, I. (2023). The influence of learning motivation on high school students' mathematical creative thinking ability. Union: Jurnal Ilmiah Pendidikan Matematika, 11(3), 487-495.

Sanjaya, W. (2006), *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*. Kencana Prenada Media Group : Jakarta.

Sanjaya, Wina,. (2014). *Media Komunikasi Pembelajaran*. Jakarta : Kencana Prenada Media Group.

Sardiman, A, M. (2016). *Interaksi dan Motivasi Belajar Mengajar*. PT Raja Grafindo Persada : Jakarta.

Septiawan. Arini. Sudatha, W. (2014). Penerapan Model Pembelajaran Sains Teknologi Masyarakat (STM) Berbantuan Media Audio Visual untuk Meningkatkn Hasil Belajar IPA pada Siswa Kelas V Semester Ganjil di SD Negeri 2 Sudaji, Kecamatan Sawan, Kabupaten Buleleng Tahun Pelajaran 2013/2014. *Jurnal Mimbar PGSD Univeristas Pendidikan Ganesha Jurusan PGSD*. Vol 2. No 1.

Sofia, S., Syaidah, K., & Shunhaji, A. (2023). Principal's Effective Communication and Teacher Performance: A Classroom Perspective. Kelola: Jurnal Manajemen Pendidikan, 10(2), 101-114.

Sopwan, I. D. (2022). Pengaruh Pendekatan Science Technology Society (Stm) terhadap Hasil Belajar Siswa pada Materi Ekosistem Di SMP It Ma'arif Al Ghozali. *SINAU : Jurnal Ilmu Pendidikan dan Humaniora, 8*(1), 1-13.

Sulistiyowati, T. and Kristanto, A., (2018). Pengembangan Media Video Animasi Tentang Pembentukan Tanah Bagi Siswa Kelas V SD Negeri Singowangi Kec. Kutorejo Kab. Mojokerto. *Jurnal Mahasiswa Teknologi Pendidikan*. Volume 9, Nomor 2

Sujanem, Rai. (2006). *Optimalisasi Pendekatan STM dengan Strategi Berbasis Masalah dalam Pembelajaran Statis dan Dinamis sebagai Upaya Mengubah Konsepsi Siswa, Meningkatkan Literasi Sains dan Teknologi Pelajar Kelaas II3 SMU N 1 Singaraja*. Laporan Penelitian. STKIP Singaraja.

Surip, Muhammad. (2017). *Berpikir Kritis - Analisis Kajian Filsafat Ilmu*. Jakarta: Halaman Moeka

Sutarno. (2014). Pengaruh Penggunaan Media Audio Visual Terhadap Motivasi Belajar Kompetensi Dasar Sistem Rem Siswa, *Gardan*, Vol.1(4) : 145

Sya'bania, N., Megati, A., Gleko, G., & Pio, F. (2022). The Effect of Powtoon Animation Media towards Motivation and Learning Outcomes of Student on Chemical Equilibrium Material. Jurnal Scientia, 11(01), 261-267.

Syah, M., (2003). *Psikologi Pendidikan dengan Pendekatan Baru Edisi Revisi*.Bandung : Remaja Rosdakarya

Wenno, I. H. (2008). *Strategi Belajar Mengajar Sains Berbasis Kontekstual*. Yogyakarta : Into Media

Yunita. (2014). *Model-model Pembelajaran Kimia*. Bandung : CV.Insan Mandiri.