The Effectiveness of Community Science Technology Strategy (STM) through The Development of Hydrocarbon Material E-Module on Creative Thinking Ability of Students of Class XI Mipa SMA Negeri 1 Binjai Langkat

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Abstract. The purpose of this study was to determine the analysis of the need for e-modules that can improve student learning outcomes, obtain -based e-modules. Science Technology Society (STM), and knowing the students' responses the effectiveness of the Science Technology Society (STM) learning strategy through the e-module of hydrocarbon material and creative thinking skills. Research methods, this type of research is included in qualitative research. The subjects of this study were students of class XI SMA. Data analysis used curriculum analysis, learning needs analysis and distributing validation test questionnaires along with student response questionnaires totaling 35 students. Based on the research results obtained from the answers to the validation test of student learning outcomes, the lowest score for the initial test was 30, while the highest score was 75. The lowest score for the final test was 55, and the highest score was 85. To see the completeness before and after the e-module was applied based on science and technology society (STM). The data obtained before learning activities using e-modules based on community science technology (STM) showed that 7 people completed with a completeness percentage of 22%, while for the number of students who did not complete as many as 25 students with a percentage of 78%. After learning with the e-module based on community science technology (STM) on hydrocarbon learning, 26 students completed the study, and 6 students did not complete it. Then the percentage of the number of students who completed was 81%, and 19% did not complete. The average g is 0.44, indicating that the creation of hydrocarbon material e-modules has improved medium-level learning outcomes following Social Technology Science (STM) instruction.. The results of testing student responses to community science technology (STM) based e-modules on hydrocarbon learning that have been developed obtained an average percentage of 87% meaning that the e-module has a very good category with a range of 80% - 100%.

Keywords: community science technology (STM), e-module, effectiveness, response, Hydrocarbons

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1. Introduction

The importance of education in shaping the 's next generation. With education it creates a generation that is able to build itself, so that the quality of education can be improved which is more potential, motivated, innovative, and creative capable of contributing to the life of society, nation state. Schools are formal educational institutions that are in charge of teaching students how to work, think outside the box, be motivated, and be creative in the nation's intellectual life.As a result, it eliminates the most significant factor in enhancing student learning outcomes.Teachers and learning models are two of them in realizing the school learning process.The educator is the lead for the progress of understudies in the process In learning, the instructor gives a vital job in doing the viability of the STM (Science and Innovation People group) learning technique on hydrocarbon material on the capacity to think imaginatively to understudies.The ability of teachers to comprehend the learning process is crucial to the school's achievement of learning objectives.Curriculum revised in 2013 and 2017.The 2017 revised 2013 curriculum places an emphasis on learning using a scientific approach known as x five (5) M learning activities, which include observing, asking questions, collecting data, associating, and communicating. These activities are based on Permendiknas number 22 of 2016 concerning process standards. It is hoped that the standard of graduate that will be sought in the study program must be described briefly and in detail which will then achieve the learning outcomes that will be produced by students.

To achieve learning effectiveness of the STM (Science and Technology Community) learning strategy on hydrocarbon material on the ability to think creatively, internalize and accumulate knowledge, skills, attitudes, and competencies that are achieved through a structured educational process and the scope a field of chemistry education. Chemistry is one of the science materials in education which is a compulsory subject for Mathematics and Natural Sciences students, chemistry itself has a nature. Ananda in Kurniyaningsih et al., (2019) explains that the nature of chemistry consists of two things, namely chemistry as a product and chemistry as a process. Chemistry as a product in the form of knowledge consisting of facts, concepts, and chemical principles. Chemistry as a process in the form of skills and attitudes possessed by scientists to acquire and develop chemical knowledge. Hydrocarbon material is one of the materials that requires creative thinking skills, because in understanding the material students are expected to be able to determine names of hydrocarbon compounds in order to complete a reaction from hydrocarbon compounds based on the classification of compounds. There are many reasons that students have difficulty in learning chemistry, including a lack of understanding of the basic concepts of chemistry. (Hand & Treagust in Cartrette & Mayo, 2011). And the learning approach used by the teacher, lack of teaching materials and the availability and use of laboratories that are less than optimal (Pinarbasi & Canpolat, 2003). Based on the results of interviews with chemistry teachers at SMA Negeri 1 Binjai Langkat. namely the ability to understand the concept of students in the very poor category is on the indicator grouping of hydrocarbon compounds and describing the structure of alkenes, physical properties based on relative atomic mass and physical properties based on structure. The ability to understand concepts of students in category k is good for indicators of the specificity of the carbon atom, the position of the carbon atom , naming alkane compounds, naming alkene compounds, naming alkyne compounds . Effectiveness is related to classroom factors that personally affect teaching and learning activities. Effectiveness can be measured based on the effect of a goal or target that has been influenced

previously. The effectiveness paradigm rests on a valid measurement of performance in an organization or within a unit within it. (Amanatie, 2010).

One of the effectiveness of learning strategy that is interesting to students is the effectiveness of the science technology strategy of the community. The effectiveness of the community science technology strategy (STM) is one of the effectiveness of the learning strategy promising enough to meet expectations for students. Learning effectiveness is an effective teaching attitude shown by educators who can convey experiences through special approaches and tactics to achieve learning objectives. Learning strategies on hydrocarbons tend to be conventional, which is considered effective because it doesn't take a time. The strategy used by the teacher is the delivery of material, discussion, and practicum. With the practicum students are more understanding, more active, and creative in learning on the hydrocarbon material on creative thinking skills. The word effective comes from English, namely effective which means successful or something that is done successfully. Popular scientific dictionaries define effectiveness as the appropriateness use, use or support goals . The notion of effectiveness is a judgment made with respect to individual, group, and organizational achievement **.** The closer their are to the expected performance (standards), the more effective they are judged to be . From the understanding above, the researcher concludes that in level success achieved is in accordance with the objectives, namely in learning the effectiveness of STM learning strategies through the development of e-modules on Hydrocarbon material on the creative thinking skills of SMAN 1 Binjai Langkat students.

The community science technology learning model utilizes thinking skills in cognitive processes that involve mental processes and are faced with the complexity of a problem that exists in the real world so that students are expected to have a complete understanding of a material formulated in problems, mastery of positive attitudes, skills gradually and continuously. Ardi, 2010). Having a fundamental knowledge of science is very essential to form a scientific literate human being. Individuals who are scientifically literate have the ability to use the fundamental aspects of science in solving problems in everyday life, and in making decisions for public and personal interests (Priyantini et al., 2015). With the learning model based on the events in In this society, students will find it easy to form scientifically literate humans . Individuals who are scientifically literate have the ability to think creatively and apply the material to be studied so that will increase students' understanding In addition to the community science technology learning model (STM), teachers must also take advantage of media that can foster student creativity and response. Nowadays, e-module learning media has been known, namely: The module is one of the teaching materials that is systematically arranged to be easily understood by students according to their age and level of knowledge so that they can be used independently with guidance from educators (Prastowo, 2012). With the development of e-modules, it can help students and teachers in the learning process in the classroom by using e-modules, learning carbon dioxide becomes much easier for students to understand and remember. Several studies have been conducted on the Community Science Technology (ST M) learning model in improving students' creative thinking skills, including the research of Maemunah & Maryuningsih (2013) which concluded that there were differences in the increase in creativity between students when learning to apply the community science technology model and students who does not apply the science technology model of society. With the development of the e-module , it shows that the scientific model society technology can improve student creativity and student response to hydrocarbon material.

2 Literature Review

Definition of Effectiveness can be measured based on the effect of a goal or target that has been influenced previously. The effectiveness paradigm rests on a valid measurement of performance in an organization or within a unit within it. (Amanatie, 2010). According to Fathurrohman & Sutikno (2017) in his book, the teaching and learning process is a series of activities that are agreed upon and to achieve educational goals optimally. Learning and teaching are activities that take place simultaneously, simultaneously and simultaneously. have a shared focus. As a activity , learning has a permanent goal, namely the occurrence of changes in students . Learning strategies are components of a set of materials including activities before learning, and student participation which is a learning procedure used in subsequent activities (Dick and Carey 2005) . Strategy can be understood as an outline of guidelines to act in an effort to achieve the goals that have been set. (Donni Juni Priansa, 2017). The learning strategy hydrocarbons has components that must be understood and studied in order to achieve effective and efficient objectives. For example: students understand about the notion of a simple carbon compound is a hydrocarbon, that is, a compound that only contains elements of carbon and hydrogen. Hydrocarbons are classified into two main types, namely aliphatic and aromatic. And the naming of alkanes, alkenes, alkynes, and their structures. In this study, the model used is the Social Technology Science learning model. The implementation of science teaching in the Social Technology Science learning model according to Anna Poedjiadi (2010) , is divided into four stages, namely the invitation stage, the formation stage draft, concept application stage in life, and concept consolidation stage.

a. In the first stage of the invitation, Asking questions about phenomena, relevant problems to stimulate students' curiosity and interest in learning know things what they already know (early knowledge). Students respond individually or in groups.
b. In the second stage of Exploration Giving assignments students get enough information through reading, observing, interviewing, discussing or doing worksheets .
c. The third stage is Explanation and solution i Give the task to make a report, and present the results of the investigation or experiment briefly.
d. On Step fourth Follow up . Provide an explanation of the actions to be proposed based on the results of the investigation. Provide problem solving solutions or make decisions and provide ideas.

E-Learning Module

E-modules as one of the media and learning resources can help students to learn independently, because learning materials are designed systematically based on the curriculum and packaged in a more efficient digitalization form so that students will see real problems in the form of animations, pictures, and videos (Sidiq, et al. 2020). To achieve the goal of learning chemistry in the form of increasing students' mastery of concepts, appropriate teaching materials are needed in the form of electronic modules (e-modules) that are able to direct students to remain creative, think critically, communicatively and can collaborate with other students to learn independently. Based on this, this study aims to describe the feasibility of class XI chemical e-modules for hydrocarbon compounds. Students' creative and productive thinking habits will be sparked by the use of electronic modules in the learning process, which will also create positive, innovative, interesting, and effective conditions that can help them develop chemical literacy skills (Nerliana, 2022). Module teaching materials

are self-study packages for students that include a series of planned and designed learning experiences to help students accomplish learning objectives.In accordance with Russell. (Anna Juniar, 2019).

Hydrocarbons

Hydrocarbons are compounds that contain only the elements carbon (C) and hydrogen (H). Test for hydrocarbon compounds: the compound is burned completely to produce CO_2 and H_2O gas. Test C →$CO_{2\ gas}$ formed is flowed into lime water to form a white precipitate (lime water becomes cloudy). Test H →gas H_2O formed is given cobalt paper so that the color of the paper changes from blue to pink. Hydrocarbons are classified as aliphatic (open/straight chain) hydrocarbons. and cyclic (closed-chain) hydrocarbons . Aliphatic hydrocarbon compounds: Alkanes are the simplest saturated hydrocarbons which are a series of compounds that fulfill the general formula $C_nH_{2n+2,}$ also called paraffins. The first term to the tenth term in alkane compounds can be obtained by substituting the value of n into the formula, where n is a natural number and is the number of C atoms present. alkane hydrocarbons. Farmers who ripen fruits also use a lot assistance from hydrocarbon compounds, namely ethyl gas . Alkenes (C_nH_{2n}) . _ Straight Chain of Carbon Atoms double bonds (–C=C–) are numbered indicating the double bond. Alkenes have various uses in everyday life, including;

1. Ethylene and propylene are used in industry , Ethylene and propylene as ethene and propene, are the two most widely produced organic chemicals industrially. Both are commonly used in the production of raw materials, including various objects made of plastic .
2. Polypropylene produced from propylene or propene , Polypropylene produced from propylene or propene used as molded articles (eg kitchen utensils); fiber for indoor-outdoor and other carpets.

Alkyne Molecular Formula

Alkynes are hydrocarbon compounds with triple bonds (–C≡C-). The general formula for alkynes is: C_nH_{2n-2} . Uses As a raw material for the manufacture of other organic compounds such as ethanal, ethanoic acid, and vinyl chloride . Raw material for the manufacture of carbide gas which is useful in accelerating the fruit ripening process. Chemical reactions in alkanes, alkenes, and alkynes include: substitution reactions, addition reactions, oxidation reactions, and elimination reactions . Isomers are compounds that have the same molecular formula but different structures . Isomers are divided into two, namely structural isomers and geometric isomers. Structural isomers are divided into 3: skeletal isomers, position isomers, and functional group isomers.

3. Methods

This research will be conducted at SMAN 1 Binjai Langkat, in the odd semester of Academic Year 202. Jln Suakamakmur. cac. Binaji. Regency. Langkat. The population in this research is all students of SMA Negeri 1 Binjai Langkat in the academic year 2022/2023, totaling 1 class The average number of students per class is ± 30 students. The sample in this research is class students with a total of ± 36 students. Class The sample was given treatment

with the Science Technology Society (STM) model through the development of the hydrocarbon material e-module.

The x students' chemistry, specifically the pretest and posttest, served as the instrument for this study.The purpose of the pretest, which was administered to the sample prior to treatment (or treatment), was to determine the normality or characteristics of the students' initial abilities.Posttest is given after the finish of the treatment cycle (treatment) with the point of the improvement of understudies' inventive capacities.

Table 1. Research design *Pretest-posttest control group design*

Prettest	***Treatment***	***Posttest***
O_1	X_1	O_2 _

(Sugiono, 2008)

Information :
O_1 = Giving the initial test (*Prettest)* .
O_2 = Giving the final test (*Posttest*)
X_1 = Treatment of the experimental group by applying the e-module Developed hydrocarbons.

In this study, the data processed were questionnaires for the feasibility test of e-modules according to the BSNP, and student response questionnaires to learning Science Technology (STM) through the developed e-module.

Data collection technique
The research procedure is illustrated in the chart described in Figure 1:

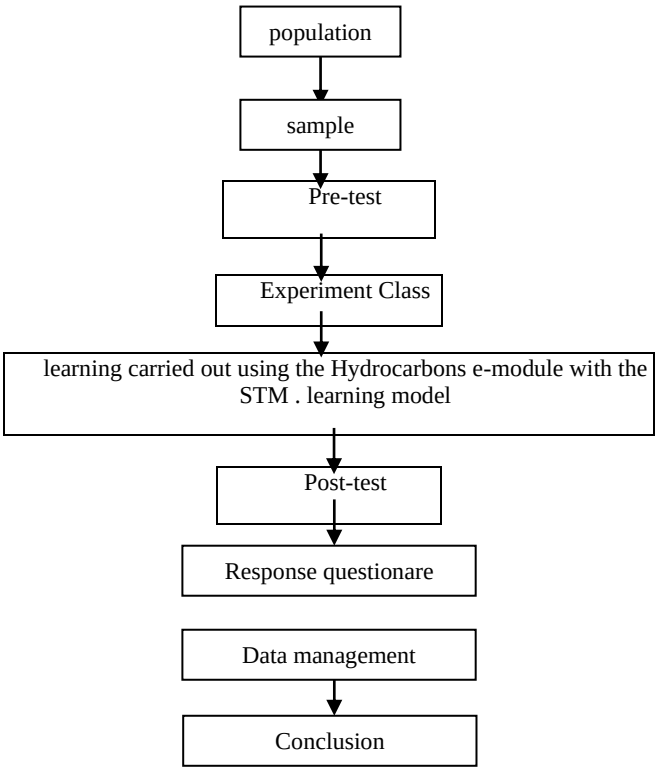

Figure 1. Hydrocarboan E-module Trial Procedure with the Social Technology Science (STM) learning model.

Research Instruments

Researchers made 3 (three) instruments to support the data. The instruments used in this research are:

1. Instruments Tes.

The test instrument for learning outcomes used in this research is *multiple choice* questions with 20 questions regarding hydrocarbon material, consisting of multiple choice questions with five choices of a, b, c, d, and e). The grid of test questions is arranged based on indicators that must be achieved by students. The learning outcomes test questions are designed by according to Bloom's *taxonomy* which consists of aspects of knowledge (C1), understanding (C2), application (C3), analysis (C4), and evaluation (C5). The test questions for learning outcomes were given during the *pretest* before being taught the hydrocarbon e-module which was developed with the social technology science (STM) learning While the *posttest* was given after was given treatment. Before the test instrument for learning outcomes is given to the research sample, there are several tests that must be carried out on the instrument validation test, test reliability, item difficulty level, test discriminatory power and distractor test.

Validation test

The criteria used in the validation test is if r count > r table, then the question is said to be valid. For N=30 at the significance level = 0.05, the r table is 0.36. Criteria questions are not valid, the number of questions is 5, the percentage is 16.70%. As for questions, the number of questions is 25, the percentage is 83.30%. So the total number of valid and invalid questions is 100%. And obtained the average r count s of 0.44. This indicates that if r count > r table, then the question is valid

2. Hydrocarbon E-module Eligibility

The material from this researcher was carried out using qualitative and quantitative data, to obtain data descriptive analysis using the percentage score. This research, using rating scale is 1 to 4, where the highest score is 4 and the lowest score is 1. Determination of the range can be known through the range of the highest score minus the range of the lowest score divided by the highest score.

3. Student Response Questionnaire

Students' responses to the learning of Science Technology Society (STM) through the e-module of hydrocarbon material.

4 Results and Discussion

After implementing Community Science Technology (STM) learning through the development of hydrocarbon material e-modules and testing the test instrument using *google form* , the data obtained from student learning outcomes from research were obtained from the results of *pre-test* and *post-test data*

Table 2 Description of Student Learning Outcomes

Description *of*	***Pre-Test Score***	***Post-Test* Score**
Lowest Value	**30**	**55**
Top Rated	**75**	**85**
Average	**55**	**75.78**

The lowest score for the initial test was 30, while the highest value was 75. The lowest score for the final test was 55 and the highest score was 85. This was influenced by the Science Technology Society (STM) learning through the development of hydrocarbon material e-modules.

To see the students' mastery before and after the implementation of Community Science Technology (STM) learning through the development of hydrocarbon material e-modules in table 1.3 below:

Table 3. Description of Student Completeness Percentage Before and After Learning

Information	**Before Learning**	**After Study**
Total Complete	7	26
Total Incomplete	25	6
Percent Complete	22%	81%

Percent Not Complete	78%	19%

Based on table 3, the data obtained before the Community Technology Science (STM) learning activities through the development of the hydrocarbon material e-module showed that 7students who completed with percentage of 22%, while for the number of students who did not complete as many as 25 students with a percentage of 78%. After learning Community Science Technology (STM) through the development of the hydrocarbon material e-module, the number of students who completed was 26, with a percentage of 81%, while the number of students who did not complete was 6 students with a percentage of 19%.

The implementation of Social Technology Science (STM) learning through the development of e-modules on hydrocarbon materials has an influence on students so that students' scores have increased. Based on the results of the normalized Gain value, the data in table 1.4 is obtained as follows:

Table 4. Normalized Gain Value

Average n-gain	Classification	highest n-gain	lowest n-gain
0.44	Medium	0.69	0.17

Based on table 4 obtained an average g of 0.44 which means that there is an increase in learning outcomes in the medium category after learning Social Technology Science (STM) through the development of hydrocarbon material e-modules. So that students are able to improve learning outcomes.

In the final stage of learning Community Science Technology (STM) through the development of e-modules on hydrocarbon material, students gave responses to the e-modules that had been developed. The instrument used to data on the percentage of students is a questionnaire containing 20 questions. The results of testing student responses to Social Technology Science (STM) learning through the development of hydrocarbon material e-modules can be seen in Table 5 as follows:

Table 5. Student Response Test Results

Class	Percentage of Student Responses	Description
XI	86%	Very Good

Based on table 5, it can be seen that the percentage value of students' responses to Social Technology Science (STM) learning through the development of hydrocarbon material e-modules that have developed an average percentage value of 86% means that e-modules have a very good category with *a range of* 80% - 100%.

Discussion

This study involved 1 class, namely class XI MIPA 3 at SMA Negeri 1 Binjai Langkat Experiment which was taught using the Social Technology Science (STM) learning model through the development of hydrocarbon material e-modules. Starting with the research

sample, 25 pretest *items* were given before the study was validated to determine the students' initial understanding. Furthermore, students are given instruction using the Social Technology Science (STM) learning model through the development of hydrocarbon material e- . After that, a *posttest is given* to determine the understanding of students after learning is complete experienced a significant increase in each meeting and the results obtained in this study through the *pretest* and *posttest* with the average *pretest* 55 and *posttest* average 75.78. Because learning activities use Social Technology Science (STM) learning model through the development of hydrocarbon material e-modules.

Then the criteria used in this test is if r count > r table, then the question is said to be valid. For N=30 at the significance level = 0.05, the r table is 0.36. Criteria questions are not valid, the number of questions is 5, the percentage is 16.70%. As for questions, the number of questions is 25, the percentage is 83.30%. So the total number of valid and invalid questions is 100%. And obtained the average r count s of 0.44. This indicates that if r count > r table, then the question is valid To see student completeness before and after the implementation of Community Science Technology (STM) learning through the development of hydrocarbon material e-modules, data obtained before the Community Technology Science (STM) learning activities through the development of hydrocarbon material e-modules that 7 students completed with percentage of 22%, while for the number of students who did not complete as many as 25 students with a percentage of 78%. After learning Science Community Technology (STM) through the development of the hydrocarbon material e-module obtained the number of students who completed 26 students, with a percentage of 81%, while for the number of students who did not complete as many as 6 students with a percentage of 19%. The implementation of Community Science Technology (STM) learning through the development of hydrocarbon material e-modules has an influence on students so that student scores have increased, an average g of 0.44 means that there is an increase in learning outcomes in the medium category after learning Community Technology Science (STM) through development of hydrocarbon material e-modules. So that students are able to improve learning outcomes. In the final stage of learning Community Science Technology (STM) through the development of e-modules on hydrocarbon material, students gave responses to the e-modules that had been developed. The instrument used to data on the percentage of students is a questionnaire containing 20 questions. The results of the test student responses to Social Technology Science (STM) learning through the development of hydrocarbon material e-modules, it can be seen the percentage value of students' responses to Social Technology Science (STM) learning through the development of hydrocarbon material e-modules that have developed an average value a percentage of 86% means that the e-module has a very good category with *a range of* 80% - 100%.

5. Conclusion

Based on the results of the analysis and discussion, it can be concluded, After learning Social Technology Science (STM) through the development of the hydrocarbon material e-module, it was obtained that the number of students who completed 26 students, with a percentage of 81%, while for the number of students who did not complete as many as 6 students with percentage 19%. It has an influence on students so that students' scores have increased, an average g of 0.44 means that there is an increase in learning outcomes in the medium category after learning Social Technology Science (STM) through the development of hydrocarbon material e-modules. So that students are able to improve learning outcomes. And it can be seen the percentage value of students' responses to Social Technology Science

(STM) learning through the development of hydrocarbon material e-modules that have developed an average percentage value of 86%, meaning that e-modules have a very good category with *a range of* 80% - 100%.

References

[1]. Adah, E. N, Kurniawati, D and Yunita. 2016. Analysis of Student Cognitive Ability on Acid-Base Concepts Using Tests Based on Revised Bloom's Taxonomy. *Journal of Chemistry and Education Vol.1 No 1* . Banten: Sultan Ageng Tirtayasa University .

[2]. Anna Juniara, J. S. (2019). Pengembangan Bahan Ajar Reaksi Redoks Berorientasi PBL (Problem Based Learning). *TALENTA Conference Series*, 260.

[3]. Amanatie & Sumiati.(2010). The Effectiveness of Experimental Methods in Chemistry Learning at SMA Negeri 2 Yogyakarta. *Journal of Mathematics and Science Education* 2 (15): 83-92.

[4]. Anna Poedjiadi. 2005. *Science Technology Society* . Bandung. PT Youth Rosdakarya .

[5]. Ardi, M. Aryani, L. The Relationship Between Perception of Organizations and Interest in Organizations in Students. *Journal of the Faculty of Psychology* UIN Suska

[6]. Dick, W and L. Carey, JO Carey. 2005. *The systematic Design of Instruction. New* York: Logman

[7]. Donni Jun Priansa. 2017. *Integrated Marketing Communication in the Age of Social Media* . Bandung: CV PustakaSetia.

[8]. Fathurrohman, P., & Sutikno, SM (2017). Teaching and Learning Strategy Through Planting General Concepts & Islamic Concepts. Bandung: Reflika Aditama.

[9]. Kurniyaningsih, B., & Yonata, B. (2019). Student Activity Sheets Based on Guided Inquiry To Train Students' Creative, 8(1), 75–81.

[10]. Nerliana Sihombing, R. D. (2022). Pengaruh Model Learning Cycle Berorientasi Collaborative Learning Berbantuan E Modul Laju Reaksi terhadap Kemampuan Pemecahan Masalah Siswa. *Jurnal Indonesia Sosial Sains* , 421.

[11]. Pinarbasi, T., Sozbilir, M., & Canpolat, N. (2009). Prospective Chemistry Teacher's Misconception About Colligative Properties: Boiling Point Elevation and Freezing Point Depression. *Chemistry Education Research and Practice, 10*, 273-280. doi : 10.1039/b920832c

[12]. Sidiq, Umar and Miftachul Choiri. *Qualitative Research Methods in Education* . Ponorogo: Nata Karya, 2019.

[13]. Sugiyono. (2016). Educational Research Methods. Bandung: Alphabeta.