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The Influence of Technological Pedagogical and Content Knowledge (TPACK) Approach on Science Literacy and Social Skills

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ABSTRACT

The purpose of this study was to determine the effects of Technological Pedagogical and Content Knowledge (TPACK) approach to scientific literacy and social skills of students. The research is a quasi-experiment design of pretest and posttest control group. The research population were all students at 11th grade of natural science classes consisting the 1st, 2nd, 3rd and 4th classes in SMAN 2 Banguntapan and the total were 118 students. The used samples were 1st and 2nd classes and had 62 students in total. The sampling technique is cluster random sampling with the 1st class of 11th grades of natural science as the control group and the 2nd class of 11th grade of natural science as the experimental group. The treatment given to the experimental group was the learning the rate of reaction by using the TPACK approach with *discovery learning* models, while that of the control group was learning rate of reaction by using *teacher-center* approach with direct instructional model. The data collection tolls were the test of science literacy, consisting social skill questionnaire and social skill observation sheet. The data analysis technique was MANOVA by using SPSS and Rasch models applying Ministep. The results showed that there were an influence of the TPACK approach to science literacy and social skills of students at the level of significance ($p=0.00<0.05$). The influence of the TPACK approach to science literacy *(sig.*= 0.00), and no influence of the TPACK approach to social skills of students of SMAN 2 Banguntapan with a significant value *(sig.*= 0.137).

Keywords: TPACK approach; science literacy; social skills; senior high school students.

INTRODUCTION

The curriculum released in 2013 formulated that learning process should be able to develop the attitudes, knowledge, and skills (Kemendikbud, 2013). It has purpose to prepare Indonesian to have the ability to live as individuals and citizen who are godly, productive, creative, innovative, and affective and give contribution to the society, nation, state, and world civilization. The process of learning chemistry should be implemented by many integrating aspects such as attitude, knowledge and skill (BSNP, 2006) to develop scientific literacy and social skills of students and achieved the goal of the 2013 Indonesian curriculum

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and the national education. In process of learning chemistry or other scientific subjects, students are not only given limited factual knowledge, but they also need to be trained to explore and implement their ideas related to science (Knain, 2005).

Currently there are many schools that implement the teacher centered learning process in which students receive the information from teachers and teachers do not encourage students to gain knowledge by themselves. As a result, students tend to be passive and have less ability to work in team. In addition, students have less encouragement to solve problem that becomes the subject of learning, use scientific ability to scientifically explain the phenomena, and collect information and scientific evidence. Thus, student motivation and achievement stay low for scientific literacy.

The scientific literacy ability of Indonesia in 2006, 2009, and 2012 was ranked 50th of 57 participating countries, 60th of 65 participating countries, and 64th of 65 participating countries respectively (OECD, 2013). Lau (2014) explained that scientific knowledge of East Asian students stays low, but their interest and desire are high to learn. It is caused through implementing the traditional teaching method, little activity and interaction in the class and the lack of emphasis on the application of science or knowledge. Since the learning activities have not fully involved students in the process of acquiring knowledge, the science literacy of students is low. It is possible to overcome this by applying a learning that can make students actively involved in the process of discovery knowledge and can drill students in solving problems presented in the form of animation, simulation, or video.

One of the methods to improve scientific literacy skill is to adopt TPACK approach in the learning process. TPACK approach is a learning approach that combines content, pedagogy, and technology (So & Kim, 2009; Bozkurt, 2014; Khan, 2011; Park, Jang, & Chen, 2011). Li (2012) also said that TPACK is an approach depends on a principle as “learning is the basis to broaden knowledge, understand scientific investigation, implement effective teaching methods for science”. TPACK approach can be integrated with the model that can train students to independently gain new knowledge, even it still gives teachers occasion to provide guidance. One of models that can be used is discovery learning model. In this model, teachers do not present the teaching material in the final form, but students are encouraged to acquire their knowledge and construct it to gather new knowledge (Shah, 2004; Klauge 2011; Suminar & Meilani, 2016; Balim, 2009). TPACK approach when combined with the discovery learning model, encourages students to solve problems that become learning topics, using their scientific ability to scientifically explain the phenomenon, and to collect information and scientific evidence for problem solving. Thus, students must be trained for scientific literacy.

TPACK approach with discovery learning models encourages students to solve problem which is the subject of learning by integrating technology, pedagogy, and content knowledge. The chemistry curriculum designed to plan and implement learning activities using technology as a pedagogical goal to be very effective in student learning process (Pekdag, 2010). Learning by using TPACK approach rely on scientific literacy, which is the ability to explain scientific phenomena and collect information as well as scientific evidence to scientifically solve the problem and increase the social skills. In discovery learning students are required to perform various activities to collect information, compare, categorize, analyze, integrate, reorganize the material and make conclusions. The learning stages of discovery learning model are stimulation, problem identification, data collection, data processing, verification, and generalization (Suminar & Meilani, 2016; Kemdikbud, 2013; Syah, 2010:243).

Scientific literacy is the ability to apply science to identify questions and draw conclusions based on scientific evidence (Ardianto & Rubini, 2016; Bybee, 2008; Holbrook & Rannikmae 2007; Murcia, 2009; Schroeder, Mckeough, Graham, Stock, & Bisanz , 2009).

The scientific literacy is the ability to master scientific content (knowledge), scientific process (competencies), scientific context, and attitude (Bybee, 2008; OECD, 2006; OECD, 2013). The scientific literacy and technology learning are previously constructed on constructivist learning principles (Park & Oliver, 2008). The high scientific literacy will be followed by increasing social skills. The scientific literacy is closely related to the social abilities of students including the understanding of science, development of intellectual skill and communication, development of character and positive attitude, achievement of the objectives in socio scientific education, and the ability to scientifically make decisions(Holbrook & Rannikmae, 2007). The scientific literacy refers to ability of a person to comprehend and apply the knowledge of chemistry in everyday life in terms of understanding of three major aspects of knowledge, awareness, and the application of chemistry in daily life appropriately and effectively (Thummathong & Thathong (2016). In his research, Roth (2007) said that the scientific literacy relates with skill in communicating with others. Students are required to be able to apply science in daily life to benefit in their own life. Social skills can be learned in the chemistry. The social skills are shown as good cooperation, enthusiasm for completing the task, good communication skill in group discussion and the respect for opinions of others (Combs & Slaby, 1977).

Learning through using TPACK approach with discovery learning model invites students to actively discuss among students to construct knowledge, carry out experiment, and answer the questions contained in the student worksheet. So, students have many opportunities to express opinions, ask questions, and respond to the opinions of others. Literacy of science and social skills can be trained by using the discovery learning model and the TPACK approach. The social skills that are expected to arise during the rate of reaction to learning through using TPACK approach with discovery learning model that is in the form of ability to work together, mutual respect, and skills to communicate. The ability to work together, mutual respect, and skills to communicate can be developed during the learning process.

The one of chemistry learning materials in the 11^{th} grade is the rate of reaction. In the rate of reaction learning, there are many opportunities for students to be stimulated to observe the chemical phenomenon, watch animation or video of the rate of reaction, the factors affecting the rate of reaction, experiment on the factors that affect the rate of reaction, and apply the concept of rate of reaction in daily life. The learning process for the rate of reaction has not yet been used through the approach and the appropriate learning model. So, the effects on science literacy and social skills have not been researched for TPACK approach and discovery learning models. This study aims to uncover the effect of TPACK approach with discovery learning model to scientific literacy and social skills of students of SMAN 2 Banguntapan., The following research questions are tried to be answered according to the aim of the study. The following research questions is: “Does the TPACK approach with discovery learning models affect the scientific literacy and social skills students?

METHODS

1. Reseach Design

The type of the research was quasi experiment. The quasi experimental methods that involve the creation of a comparison group are most often used when it is not possible to randomize individuals or groups in treatment and control groups. The research design was required to apply pretest-posttest control group (Sugiyono, 2012). In the experimental group, students were treated with TPACK approach application with discovery learning model while in the control group was given treatment of teacher centered learning with direct instructional model.

2. Participants

The research was conducted at SMAN 2 Banguntapan, Yogyakarta on October 4 to 24, 2016. The participants in this study were all of 11th grade students from the natural science classes in SMAN 2 Banguntapan and the total were 118 students. The used samples were the 1st and the 2nd class in total 62 students. The sampling technique is random sampling with the 1st class of 11th grade of natural science as the control class and the 2nd class of 11th grade of natural science as the experimental class.

3. Research Procedure

The steps taken in this study were listed in below.

Pre-study

a. To ask for permission to Head of SMAN 2 Banguntapan to conduct research.
b. To conduct an observation in the school where the research proceeded to collect information about student data, student characteristics, schedule, and suggestions that exist in schools and can be used to support the implementation of the research.

Research Preparation

The procedure of research implementation consists of two stages.

a. Determine population and sample of the research.
b. The preparatory phase: the researcher prepares the basic competencies indicator analysis, syllabus, course plans, a grid of pretest and posttest and student worksheet, skill observation sheets, social and observational sheets of the effectiveness of learning using discovery learning model and TPACK approach.

Implementation of Research

The implementation phase of the research was included three main stages.

a. Perform pretest with the same questions in the experimental group and control group.
b. Perform learning appropriate activities on the rate of reaction material with the learning set in each group, apply learning through using discovery learning model with the TPACK approach in the experimental and learning groups teacher centered conventional approach applied in control group.
c. Posttest with the same questions in the experimental class and control classes;

Analysis and Reporting of Results

a. Perform tabulation and data analysis.
b. Discussion and conclusion.

4. Instrument of Collecting Data

The instrument of this study consists of learning devices and three data-collection instruments. The learning tool is the course plan and student worksheet for the experimental group that is prepared using the discovery learning model and TPACK approach based on basic competencies in curriculum 2013. Lesson plan and student activity sheet for control group which is constructed by using direct instruction model and teacher centered approach based on basic competencies in curriculum 2013. The data collection instruments are the student science literacy test, social skill observation sheet and the questionnaire of social skills. The science literacy test consists of 8 descriptive questions with science literacy indicators compiled based on indicators of science content capabilities, science processes, and the scientific context. Student social skills observation sheets use indicators of cooperation, mutual respect. and communication skills with 3 criteria attached in the assessment rubric. Student social skills questionnaire consists of 20 statements both positive and negative. The questionnaire filled by students with three criteria, often, rarely, and never.

5. Data Analysis

The data were collected from the results of pretest and posttest of science literacy and social skills. The increase in pretest and posttest results of students was analyzed using a gain score. The data analysis techniques in this study were a multivariate analysis with MANOVA technique at significance level of 0.05 and Rasch model analysis by applying Ministep.

Analysis through using SPSS was used to answer hypotheses, while the Rasch analysis was used to determine the science literacy indicators which most affected TPACK approach, the ability level of students, and the level of difficulty of test. Before multivariate analysis of variance (MANOVA) was done through using SPSS, the assumption must be met consisting of normality and homogeneity of pretest and posttest data and the correlation between the dependent variables.

FINDINGS

1. Improvement of Science Literacy and Social Skills

Data of science literacy and social skills from control and experimental group included pretest and posttest data. The increased science literacy and social skills of students was shown in gain value from each group and can be seen on the Figure 1.

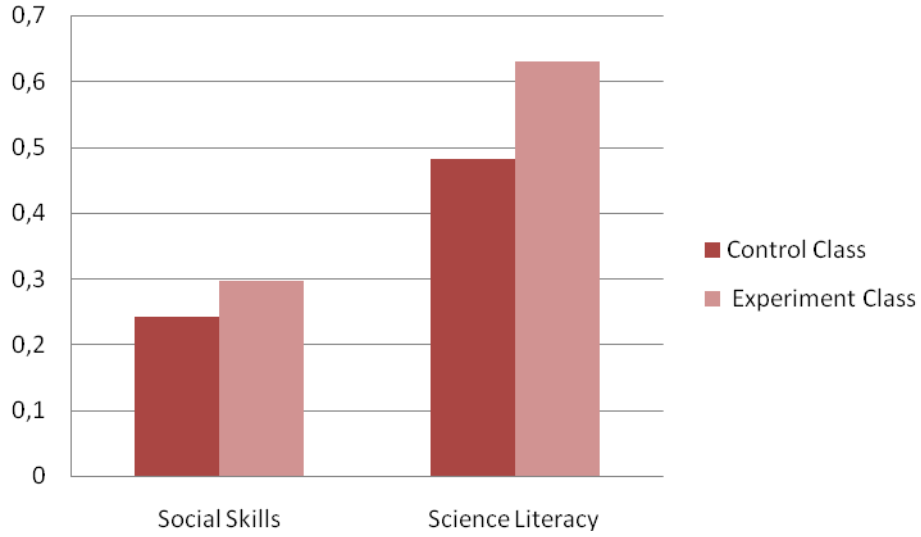

Figure 1. Improvement of The Gain Value of Science Literacy and Social Skills

2. Normality, Homogeneity and Correlation Test

The results showed the initial and final conditions of each studied variable. Normality test of science literacy and social skills was analyzed through *Kolmogorov-Smirnov* test with SPSS 16.0. and the results are shown on the Table 1.

Table 1. Results of Normality Test

No	Result	Variable	**Significance Value**	
			Control	Experiment
1	Pretest	SL	0,200	0,185
		SS	0,146	0,175
2	Posttest	SL	0,200	0,200
		SS	0,200	0,200

The significance value of normality test of science literacy and social skills was over than α (0.05). So, H_0 was accepted. This meant that the data of science literacy and social skills of control and experimental groups were distributed normally. From homogeneity test of science literacy and social skills of students, the data showed significance value by 0.246 which is bigger than the α value (0.05). So, H_0 was accepted. This meant that the data science literacy and social skills had homogeneous variances. Before hypothesis test, correlation test of dependent variable consisting of science literacy and social skills was conducted to imply the

correlation between two variables. Correlation test results are shown on the Table 2. The *Pearson correlation* and significance values were 0.341 and 0.007 respectively. The significance value was less than the α value (0.05). It meant that there was a significant correlation between science literacy and social skills.

Table 2. Results of Correlation Test

No			Science Literacy	Social Skills
1	Science Literacy	Pearson Correlation	1	0,341
		Sig. (2-tailed)	-	0,007
		N	62	62
2	Social Skills	Pearson Correlation	0,341	1
		Sig. (2-tailed)	0,007	-
		N	62	62

3. Influence of TPACK Approach to Science Literacy and Social Skills

Hypothesis test was done by using MANOVA. After correlation test had been fulfilled, MANOVA test was administered. The results of hypothesis test were shown in the significance value of *Hotteling's Trace* as 0.000. Hypothesis test results showed that significant value was less than the value of α (0.05). It meant that H_0 was rejected. It can be concluded that there was a significant effect on implementation of TPACK approach to science literacy and social skills of students at 11^{th} grade of natural science classes in SMAN 2 Banguntapan at the significance 0.05. The MANOVA test results were presented on Table 3.

Table 3. Results of MANOVA Test

Effect		Value	F	Hypothesis df	Error df	Sig
Intercept	Pillai's Trace	.944	5.020E2[a]	2.000	59.000	.000
	Wilks' Lambda	.056	5.020E2[a]	2.000	59.000	.000
	Hotelling's Trace	17.016	5.020E2[a]	2.000	59.000	.000
	Roy's Largest Root	17.016	5.020E2[a]	2.000	59.000	.000
Approach	Pillai's Trace	.229	8.751[a]	2.000	59.000	.000
	Wilks' Lambda	.771	8.751[a]	2.000	59.000	.000
	Hotelling's Trace	.297	8.751[a]	2.000	59.000	.000
	Roy's Largest Root	.297	8.751[a]	2.000	59.000	.000

a. statistical Exact
b. Design: intercept +approach

4. Partial Test of TPACK Approach to Science Literacy and Social Skills

The test of MANOVA showed not only all the test results but also the result of the partial test. The value of partial test showed a significance value for science literacy *(sig.*=0.00) that was less than the α value. It can be concluded that the TPACK approach effected science literacy of students. On the other hand, the significance value of social skills *(sig.*=0.137) was bigger than the α value. It can be concluded that the TPACK approach had no influence on the social skills of students. Test results are presented on Table 4.

Table 4. Results of MANOVA Partial Test

Source	Dependent	Type III Sum of	df	Mean	F	Sig.

		Squares		Square		
Corrected	Science Literacy	.343[a]	1	.343	17.708	.000
Model	Social Skills	.049[a]	1	.049	2.276	.137
Intercept	Science Literacy	19.157	1	19.157	989.942	.000
	Social Skills	4.486	1	4.486	208.912	.000
Approach	Science Literacy	.343	1	.343	17.708	.000
	Social Skills	.049	1	.049	2.276	.137
Error	Science Literacy	1.161	60	.019		
	Social Skills	1.288	60	.021		
Total	Science Literacy	20.846	62			
	Social Skills	5.858	62			
Corrected	Science Literacy	1.504	61			
Total	Social Skills	1.337	61			

a. R Squared = .228 (Adjusted R Squared = .215)
b. R Squared = .037 (Adjusted R Squared = .020)

5. The Most Influential Indicators of Science Literacy toward TPACK approach

Analysis result through using Rasch model with Ministep showed that the most influential indicator of science literacy toward TPACK approach applied in discovery learning model was scientific proses indicator. The results of the analysis can be seen from the variable map on Figure 2. Based on a variable map, information can be found about students' abilities and the level of difficulty of the test. The abilities of the students were shown on the left side while the difficulty level was shown on the right side.

Based on the variable map, the abilities of students in experimental group distributed equally. At the most difficult question, the students who had code P01 and P04 could solve the problem. In addition, all students could complete the easiest questions, so it shows that there was no student who needed special treatment in learning. It can be seen from the variable map that question on E1, E4, and E13 were the easiest problems for students of experimental group, then majority of students could answer them correctly. The questions on E1, E4, and E13 represented indicator of science literacy which was one of the aspects of the scientific process. Then in that case, the material for rate of reaction was the most influential indicator toward TPACK approach.

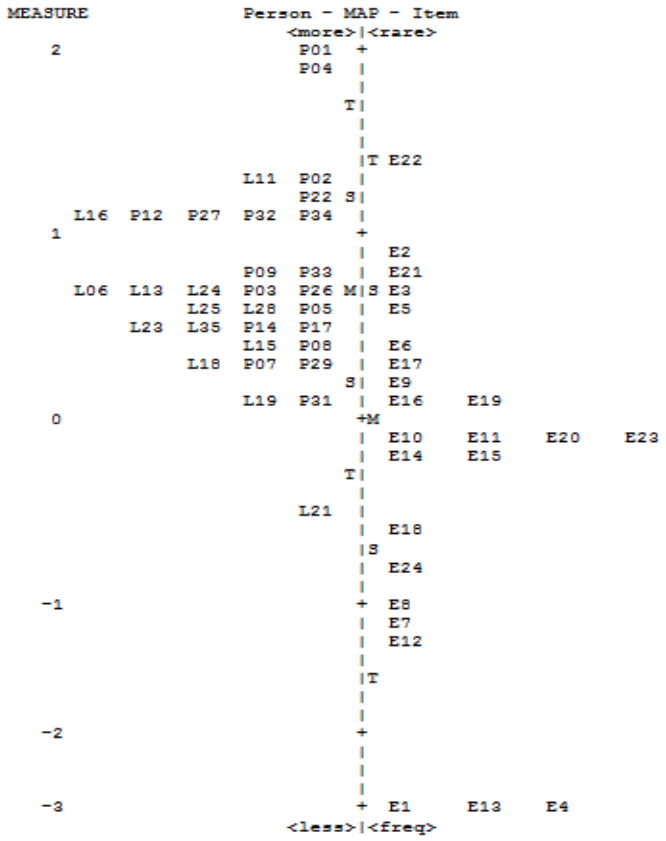

Figure 2. *Variable Map* of Science Literacy of Students

DISCUSSION and CONCLUSION

The implementation of the learning process was done four times for in the control group and experimental group. The learning process in the control group was held based on course planand student worksheets that were arranged to use teacher centered learning and followed rules in basic competencies based on curriculum-13, while experiment in the experimental group was conducted with course plan and student worksheet application designed through TPACK approaches and discovery-learning model based on curriculum-13. Before the rate of reaction material was delivered in the class, control and experimental group were given quiz about science literacy and questionnaire about social skills. And at the end of class, they were given final quiz. During the learning process, two observers observed the social skills of students and the all activities in the classes were documented via video recording.

The effect of TPACK approach to science literacy and social skills can be seen from the results of MANOVA test. the typical assumption of normality, homogeneity, and correlation had to be met before conducting MANOVA. Normality test results for pretest and posttest data showed normal distribution. Homogeneity test results indicated that the data had homogeneous variances. Correlation test results showed that science literacy significantly correlated with social skills. In accordance with the opinion of Holbrook & Rannikmae (2007) science literacy is closely related to social skills of students including the understanding of science, development of intellectual skill and communication, development of character and positive attitude, achievement of the objectives in socio-scientific education, and the ability to scientifically make decisions.

MANOVA test results indicated that significance value is smaller than the value of α.

So, it can be concluded that TPACK approach affected science literacy and social skills of students of SMAN 2 Banguntapan at the 0.05 significance level. The TPACK approach is one approach that focuses on technology, pedagogy, and materials (So & Kim, 2009; Ndongfack, 2015; Koehler & Mishra, 2009). The TPACK approach applied in the discovery learning model is learning process with discovery learning step combined with the technology in the form of animations, simulations, and virtual labs as learning media and resources. Khan (2011) said that learning involving pedagogy and knowledge content by using technology can improve conceptual understanding of students. This is also consistent with the results of the studies of Mineo, Fazio and Tarantino (2005); Drechsler and Driel (2008); Cavanaugh and Dawson (2010); Qablan, Abuloum and Al-Ruz (2009). The research of Sinaga, Kaniawati and Setiawan (2017) showed that scientific literacy increases with learning using text book related to daily life. In learning through using TPACK approach, students can increase science literacy and be accompanied by improvement of social skills of students. The result of research by Tukiran, Suyatno and Hidayati (2017) showed that the learning process used teaching materials developed from natural product chemistry (NPC) If effectively implemented to students to improve life skills, academic skills, and social skills. At the stage of stimulation, students were asked to observe phenomena, animations, or video-related the rate of reaction. Through this stage science literacy of students can evolve for example on indicators identifying phenomena/problems for subsequent investigation where students can find the key words of the problem for scientific investigation. In addition, the social skills of students can also develop for example listening to explanations of other peoples and not interrupt conversations of other people. In addition to the increasingly growing science literacy of students, social skills of students can also flourish. This is in line with the research results by Setiawati and Senam (2015) that states the development of science literacy of students are also accompanied by the development of student attitudes such as actively asking questions about IPA issues, actively answering questions about IPA issues, actively responding to friend opinions about IPA issues, with enthusiasm, honest in taking observation data, and responsible in the implementation of practicum activities.

The TPACK approach applied in the discovery learning model is constructivism learning model and contextual approach. Learning of scientific literacy and technology is the learning process built by the constructivism principles in which comprehension of students depends on their thinking process when they get involved with learning experience and it is associated with their previous understanding concept (Park & Oliver, 2008). The purpose of implementation of TPACK learning framework is to enable students to do simulations interactively by applying learning media-based animation to comprehend the concept and solve the daily problem. The TPACK approach relating in discovery learning model is learning materials combined with the technology such as animation programs, simulations, and virtual labs as media and learning resources. Darmawan (2016) said that constructivism-based learning with TPACK approach is a learning that involves the nature of knowledge needed to integrate technology in learning. The Learning with TPACK framework is implemented so that students familiarize themselves in conducting simulations in an interactive way using animation learning media directly to understand the concept and solve a problem that occurs in daily life.

The learning in the experimental group was conducted in laboratory. Integrated learning theory with more practice made students to construct comprehension well. Students were stimulated to find, try, and build their concept during learning process. After they found the sought concept, they would discuss and get explanation from teacher to develop their understanding. This was supported by the results of research by Bozkurt (2014) which explains TPACK as significantly affected the improvement of academic value for students of teaching physics. Practical learning and discussion allow students to interact with each other

and transfer knowledge. This was supported through results of research by Matthewe (2004) that the stimulant of working in team induced students to do social actions such as respect of their friends and it gave equal comprehension among students. In addition, students could collaborate more actively.

For the rate of reaction material in the experimental group, learning was done with syntax repetition of discovery learning model by TPACK approach seven times. At the first meeting, the learning proses spent time longer because students stayed unfamiliar to TPACK approach and discovery learning model. As a result, students needed more time to identify the problem based on practiced phenomenon. It was concluded by analyzing their worksheets/LKS and there were just 32% of students who answered the problems in worksheet at the stage of problem identification.

After the second meeting, the students started to adapt to follow the learning syntax because the longer the students used to follow the learning through using TPACK approach with discovery learning model. This is evidenced by the observation of the implementation of learning that reaches 100%. Consequently, they could identify the problem, explain the phenomena based on the concept of the rate of reaction, collect information, and scientific evidence to solve problem in daily life. The students longer adapted to follow the learning process by using TPACK approach applied in discovery learning models. It was detected by 98% of students answer to the questions on the worksheet correctly at the fourth meeting. Furthermore, the questionnaire about student interest showed that students tended to be active, enthusiastic, and amused during the learning rate of reaction by applying TPACK approach. It can be seen on the Figure 3.

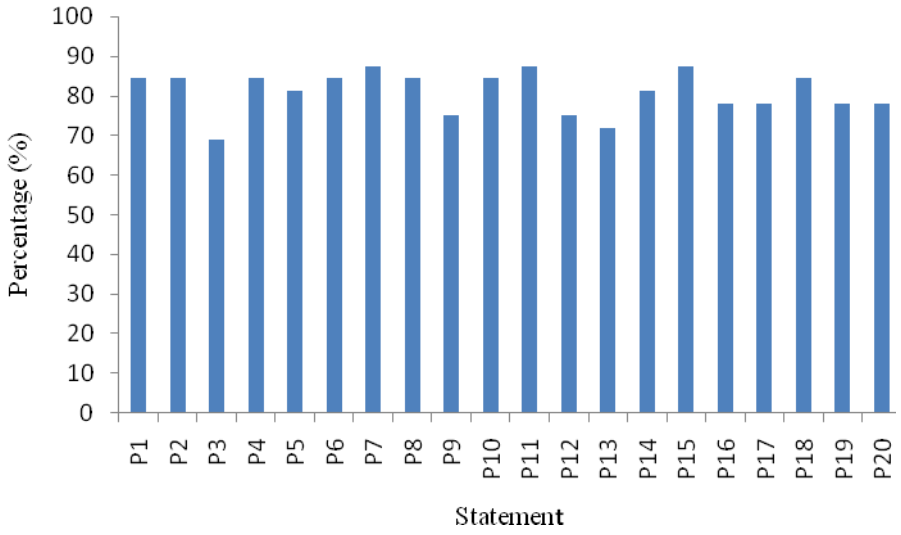

Figure 3. Graph Interests Against Student Learning

The questionnaire about student interest averagely showed 87% of students was more active, happy, and enthusiastic during the learning of the rate of reaction by using TPACK approach that involves the examples of chemical phenomena in daily life. Li (2012) said that the TPACK is an approach having principle that learning process is the basis to develop knowledge, understand scientific investigation which makes it the appropriate teaching method for science. The results of data analysis from student worksheet, in the data processing stage showed that students can explain the scientific phenomenon that occurs in everyday life and associated with the concept of rate of reaction, can explain phenomena associated with factors that affect the rate of reactions in everyday life with the theory of collision. Student ability to connect the concept of rate of reaction with daily life phenomenon

will make it easier for students to solve problems. This is in accordance with the results of the study by Carvalho, et al. (2015). This descriptive and interpretive study aims to better understand how to mobilize effective feedback in science classes by applying activities based on real life problems which intended to promote critical thinking. Science literacy is important to enable children in the principles of lifelong learning and motivates them to learn everything and apply it in daily life. In accordance with the study of Chen (2011), it said that the learning involving science literacy is effective to improve student understanding of the concept and easier to remember information and apply it. In other words, students can improve not only science literacy but also social skills by applying the method. This had something in common with the study of Setiawati and Senam (2015) which stated that the development of science literacy of students was also accompanied by the development of student attitude such as being active to ask and answer questions about the issue of natural science, active to respond opinion of friends on the about issue of natural science, active during practicum, honest to collect the observational data and responsible to do the tasks during the practicum.

In the control group, the learning for the rate of reaction took place with the teacher centered approach. The learning was done with the teacher explanation and the students take note and record the teacher explanation. This is the reason for lack of development in student science literacy in the control group. The improvement of science literacy of control and experiment group students are much different. The teachers provide opportunities for the students to discuss answers to questions presented by the teachers. In addition, the students are also grouped to conduct practicum activities and discuss questions answered by the teachers. Generally, the TPACK approach applied in discovery learning model affected science literacy and social skills. However, the partial test results of MANOVA showed that the treatment did not give effect for social skills. Although implementation of the TPACK approach improved the science literacy of student, it did not affect their social skills. The data on Figure 1 showed the improvement of social skills

experimental group did not have significant difference with control group. It was caused by same activities given both classes during learning process such as doing discussion and practicum.

The results of the Rasch analysis showed that the most influential science literacy indicator toward the TPACK approach was process aspect of science literacy. Indicators of science literacy were content, process, and context of science (OECD, 2013). The indicators of science process included identifying scientific questions, identifying problems of the phenomenon about the rate of reaction and the factors affecting the rate of reaction, describing or interpreting phenomena about the rate of reaction, explaining the phenomena associated with factors affecting the rate of reaction using the collision theory, seeking additional information to corroborate initial understanding about the factors affecting the rate of reaction, proving the correlation between phenomenon factors affecting the rate of reaction with the collision theory, applying the theory of rate of reaction to explain the phenomenon of that in daily life, and using scientific evidences to draw conclusions. The research of Sinaga, Kaniawati and Setiawan (2017) showed that scientific literacy increases with learning using text book related to daily life.

During the learning through TPACK approach applied in discovery learning model, students were demanded to construct their understanding, so they could adapt to identify the problem with a scientific phenomenon or news, explain and solve the daily life problem or phenomena associated with the rate of reaction. Consequently, their literacy could be developed in this aspect of the process. Arends (1997: 43) supported this condition with the statement that learning focusing on activities including identifying problems and discussing in groups can develop student skill to thoughtfully think and socialize. The TPACK approach

with discovery learning models had significant impact on the science literacy and skill of students in SMAN 2 Banguntapan. Partially the TPACK approach affected science literacy but had no effect on social skills. Science literacy can be seen as the indicator of TPACK approach for the TPACK aspects of the science process because the questions that represent indicators on aspects of the science process can be answered by the most students.

Suggestions

The high achievement of science literacy of students was induced by their ability to construct and connect their knowledge with the application in daily life. The opinion of Holbrook & Rannikmae (2007) expressed the same condition that science would be easy to learn when it was related with the phenomenon in human life. In experiment group, student had stimulated to observe the chemical phenomena, analyze the concept of rate of reaction in daily activity, design and conducted the experiment on the rate of reaction factor, and apply the concept of rate of reaction in daily life. So, learning process for the rate of reaction by using the TPACK approaches with discovery learning model can develop not only science literacy but also the social skills such as the ability to work in team, respect each other, and communicate. Future studies with the TPACK approach with discovery learning model can be applied to other science subjects.

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