The effect of TPACK framework on inquiry process: a study of geographic subject

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Abstract. The inquiry process constitutes one of the essential process in the learning process. Learners gain knowledge through the inquiry process to build knowledge of the information received. Teachers remains searching for the most effective learning strategy, so that students are motivated for the inquiry process. This study discusses the use the Technological Pedagogical Content Knowledge (TPACK) in the Geography learning process in high schools. The method is a quasi-experiment in the Geography learning process which was designed based on the TPACK framework to determine its effect on the inquiry process of students. The result shows that Geography learning process using TPACK framework affects the inquiry process as seen by the quality of questions raised by students. Based on the result, it can be concluded that student-involved learning process provides many opportunities for students to conduct inquiry process.

1. Introduction
In cognitive theory, the process of student inquiry is highly considered by the teacher in each stage of in-class learning process. The word inquiry in the Oxford Dictionary is defined as a process of “asking somebody for about something, requesting for information about something, investigation, and/or the act of asking question or collecting information about something or somebody.” If students can do the inquiry process independently and are always eager to obtain new information, the teacher has succeeded in providing motivation to learn. Therefore, teachers are expected to always determine various learning strategies so that they can stimulate students to conduct the inquiry process sustainably.

[5] States that inquiry process is interpreted as an activity of inquiry and/or searching to satisfy the curiosity of students.

This study attempts to observe the in-class learning process when the teacher designs the learning by considering three aspects in a symbiotic manner comprising the content of the materials, the learning method (pedagogy), and the technology included in the learning process. Framework which combines the three components is known as the Technological Pedagogical Content Knowledge (TPACK). Despite the only three aspects, this framework is complex. [3] Assert that TPACK requires comprehension of teachers on how certain technologies can provide learning experiences for students. Learning technology and learning strategy are used simultaneously to deliver learning materials.

The TPACK framework is not a recent concept, as a matter of fact, every teacher who uses technology in the learning process certainly have implemented TPACK; although not all teachers are able to implement the framework effectively, indeed, to promote the inquiry process of students. This study attempts to observe the learning process designed with the TPACK framework on Geography subject in high school. This study aims to determine whether or not the TPACK framework has significant potential to promote inquiry process on students.
2. Methods
This study uses the quasi-experimental method which aims to determine the effectiveness of certain action in the classroom on the student inquiry process. The study uses the classroom observation technique with the following steps:

- The researcher prepared learning materials with the TPACK framework. The learning materials include textbooks (learning content aspect), learning scenario (pedagogical aspect), and display and maps (technological aspect);
- The researcher asked for permission to the Geography teacher to conduct in-class learning process. The teacher who was willing is a geography teacher at SMAN 4 Batam of XI Social 1 with a total of 34 students consisting of 13 male students and 21 female students;
- The researcher recorded the learning process using a camera placed in the back;
- The recording was observed related to the implementation of learning method based on the TPACK framework. In the learning process, students were asked to raise critical questions. Questions were written on a piece of paper and collected as study data. The question was analyzed as the research variable measured in terms of its quality.

Besides the questions written on paper, the data also include responses to the learning process from teachers and students. The result is concluded to strengthen the theory stating that learning process designed with the TPACK framework potentially improve the inquiry process and skills of students in raising critical questions.

3. Results and Discussion

3.1. Geography Learning using TPACK
The difference between TPACK learning with the other methods lies in the more careful consideration in choosing learning method and technology suitable to the materials. This opinion is based on the fact that learning methods and learning technologies vary, but the TPACK method assist the selection of both.

In Geography teaching, the implementation of TPACK begins with the analysis of teaching materials based on the opportunity of contextual inductive delivery by showing the current geographic phenomena in the environment for the students to determine the general concept according to geographic theory. When selecting the opportunity of contextual inductive delivery, active learning method is chosen, one of the most effective but remain enjoyable method. In addition, learning technology is also simultaneously sought to maintain student motivations.

In this study, the geography learning designs are as follows:

a) Class started with greeting, perception, and delivering learning objectives;
b) The teacher invited students to observe the distribution map of fauna in the world through PowerPoint presentation;
c) The teacher also played video about the division of fauna in Indonesia. The teacher asked students to think critically by raising questions listed on the PowerPoint presentation;
d) The teacher asked students to read teaching materials within 5 minutes and asked them to ask questions on a sheet of paper provided;
e) The teacher asked students to find pictures of fauna they had not recognized on the internet using their mobile phone;
f) The teacher prepared a map of Indonesia. If not available, a sketch of Indonesian map on paper can be used;
g) The students were asked to attach the picture of fauna of western, central, and eastern Indonesia on the map;
h) The teacher elaborated student knowledge by asking question “why are certain animals here and not in the other?” The teacher explained the geological map of the glacial era;
i) The teacher explained and added information about the distribution of the flora and fauna in the world using PowerPoint presentation;
j) The students were asked to raise questions using the words “Why” and “How”. The questions had to be written on the provided paper;
k) The class was divided into 6 groups and each group created a concept map;
1) The teacher asked the group representatives to explain the map in front of the class. After the learning process, the researcher conducted an interview with the Geography teacher. The interview result shows that the teacher perceived a fairly positive perception of the learning scenario designed using TPACK. The teacher was more comfortable and easier to deliver the teaching materials. Thus, learning technology is able to assist teachers in the learning process, and even control the time of each learning stage. The questionnaire distributed to the students also indicated positive responses. The following is the result of the questionnaire.

**Table 1. Student motivation when teacher using teaching aid and media**

| No. | Answer                      | f  | %  |
|-----|-----------------------------|----|----|
| A   | More motivated              | 28 | 82.4|
| B   | Fairly motivated            | 4  | 11.8|
| C   | Neutral                     | 2  | 5.88|
| D   | Tiresome                    | 0  | 0   |
|     |                             | 34 | 100.00|

*Source: Research, 2019*

Based on Table 1, it can be seen that student learning motivation is significantly high; there were 28 (82.4%) students being more motivated. The reason why students are more motivated in learning, the answers are in Table 2.

**Table 2. Student perception on teacher using teaching aid and media in class**

| No. | Answers                                      | f  | %  |
|-----|----------------------------------------------|----|----|
| A   | Teacher is more enthusiastic in class        | 32 | 94.1|
| B   | Neutral                                     | 2  | 5.88|
| C   | Teacher is less enthusiastic in class        | 0  | 0   |
| D   | Teacher tends to be tiresome                | 0  | 0   |
|     |                                              | 34 | 100.00|

*Source: Research, 2019*

Based on Table 2, students assessed positively on teachers who use teaching aid and learning media in the classroom. Based on the assessment, the teacher is more enthusiastic during class. According to the researcher, such an attitude is honest and can be the reflection for other geography teachers. Another reason why students prefer learning using teaching aids and learning media is presented in Table 3.

**Table 3. Teacher habit when using teaching aid and media**

| No | Answers                                       | f  | %  |
|----|-----------------------------------------------|----|----|
| A  | Frequently asking                             | 16 | 47.1|
| B  | Frequently explaining                         | 11 | 32.4|
| C  | Frequently conducting group discussion        | 7  | 20.6|
| D  | Frequently giving assignments                 | 0  | 0   |
|    |                                              | 34 | 100.00|

*Source: Research, 2019*

Based on Table 3, it indicates that the students are happy when the teacher uses the question and answer method while using teaching aid and learning media. The answer to the question, “why do students prefer teachers using teaching aids and media?” is in Table 4 below.

Teachers are easier to implement teaching method and students participate more and more motivated in learning. To determine whether or not the method is effective, the researcher linked the impact of teaching in the TPACK framework on the ability of students to raise questions as a basic element in initiating the inquiry process. Based the questionnaire, it can be concluded that the use of technology in learning is better in creating a learning ecosystem.
Table 4. Student perception on learning using teaching aid and media (TPACK context)

| No | Answers                                      | f  | %    |
|----|----------------------------------------------|----|------|
| A  | Easier to understand the lesson              | 30 | 88.2 |
| B  | Fairly easy to understand the lesson         | 4  | 11.8 |
| C  | Slightly hard to understand the lesson       | 0  | 0    |
| D  | Hard to understand the lesson                | 0  | 0    |
|    |                                              | 34 | 100.0%

Source: Research, 2019

3.2. Quality of Students’ Questions in TPACK-based Learning

Based on the learning scenario, students are asked to raise a number of questions. There are two assignments which had to be finished by students. The first assignment is to write down their questions after reading the textbook; each student was asked to submit 3 descriptive questions. The second assignment is that each student had to ask one question by the end of the class. In this study, the quality of questions by students measured based on cognitive level according to Bloom which is further developed by Anderson and Krathwohl comprising Remember (C-1), Understand (C-2), Apply (C-3), Analyze (C-4), Evaluate (C-5), and Create (C-6).

Students were not given any information on the cognitive level by Bloom. Therefore, the question asked is natural and based on their level of curiosity to find out more about what they had not known. The number of questions in the first assignment is 3 questions x 34 students compared to the second assignment. The following is the analysis of the written questions raised by students.

Table 5. Comparison of cognitive questions raised by students related to the quality of inquiry process

| No | Answers       | First Assignment | Second Assignment |
|----|---------------|------------------|-------------------|
|    |               | f   | %    | f   | %    |
| 1  | Remember (C-1)| 28  | 25.0 | 3   | 8.82 |
| 2  | Understand (C-2)| 31  | 27.7 | 5   | 14.71|
| 3  | Apply (C-3)   | 10  | 8.9  | 2   | 5.88 |
| 4  | Analyze (C-4) | 25  | 22.3 | 12  | 35.29|
| 5  | Evaluate (C-5) | 13  | 11.6 | 7   | 20.59|
| 6  | Create (C-6)  | 5   | 4.5  | 5   | 14.71|
|    |               | 112 | 100.00 | 34  | 100.00|

Based on Table 5, it appears that there are developments in the quality of questions, the Higher Other Thinking Skill (HOTS) group which consists of analysis, evaluation, and create indicates improvement in the second assignment. It shows that TPACK-based learning affects the critical thinking skill of students as shown by the quality of the questions raised.

4. Conclusions

The result shows that learning using the TPACK framework indirectly affect the critical thinking skill of students. A relevant and balanced combination of material, pedagogical, and technological aspects results in improvement for students. The impact fosters the motivation of students to think more critically which means that the inquiry process is more developed. To integrate TPACK may not be easy, since it requires in-depth study and testing for more than once. This study is expected to provide more insights for teachers who would like to improve the inquiry process of students using the TPACK framework.

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