

TPACK-Based E-Book for Learning Chemistry in Senior High School

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Abstract—Abstract chemistry learning requires the help of teaching material that can represent chemical material into concrete material in order to help students understand chemical material. Learning chemistry that is abstract and difficult to understand if only done with the lecture method will make it difficult for students to understand the learning material. The use of teaching materials and teacher's skills in teaching are essential things that can help students in overcoming difficulties faced in the chemistry learning process. This research was conducted as a foundation to describe the need for teaching materials that integrate TPACK in chemistry learning. The research method used in this study was a survey method; then, the researcher was analyzing the data obtained descriptively. Samples were taken by purposive sampling at 35 students majoring in science in high school by using a questionnaire as a data collection instrument. The survey results found that in learning chemistry, 83.9% of students need a teaching material that integrates technology, pedagogy, and content knowledge (TPACK) to achieve optimal learning. For this reason, it is necessary to develop chemical teaching materials based on TPACK (Technological Pedagogical Content Knowledge).

Keywords: TPACK, instructional materials, chemicals

I. INTRODUCTION

Chemistry materials are one of the essential materials in the scope of learning. We have always applied Chemistry to our lives. However, we often do not realize that we live with everything related to chemistry. Chemistry material is also one of the essential materials in education as a provision of students' knowledge and understanding to communicate higher levels of education. However, apart from the various roles of chemistry in life, there is a fact that says that chemistry is considered ambiguous, and students are less interested in learning. However, despite the various roles of chemistry, many students are less interested in obtaining chemicals. One of the causes of student disinterest is due to the way the teacher accepts material that is too monotonous. Learning requires a teaching material that helps in the learning process. The teaching materials needed are teaching materials that can construct students' understanding by concreting abstract material. Also, teachers must choose goals, strategies, and teaching materials that are appropriate to the subject matter. The utilization of teaching materials in the learning process can combine technology, pedagogy teachers, and also learning materials, namely TPACK-based e-book teaching materials.

TPACK is a framework for understanding and describing the types of knowledge needed by a teacher to streamline

pedagogical practices and conceptual understanding by integrating technology in the learning environment. The interaction between the Technology, Pedagogy, and Content components in the TPACK framework has the power and attractiveness to foster active student-focused learning [1]. The TPACK strategy is applied so that students play an active role in discovering their concepts as well as increasing the achievement of students' chemical competence in students' cognitive learning outcomes towards chemical material. There are three main points that most considered necessary in TPACK. They are content pedagogical knowledge (PCK), content technology knowledge (TCK), and pedagogical technology knowledge (TPK) [2].

TPACK is knowledge of content, pedagogy, and technology in learning [3]. Knowledge of TPACK is a synthesis and is very related to ICT in the learning process in the classroom. TPACK knowledge is described as a form of knowledge and innovation [4]. As a conceptual framework, TPACK has been widely used as learning that integrates ICT. Teachers have applied the use of ICT in the development and preparation of syllabi, lesson plans, and the collection of materials in learning [5].

II. LITERATURE REVIEW

TPACK was developed based on the learning model proposed by Shulman, which explains how the understanding of content mastered by teachers, pedagogical knowledge, and technology are interconnected with each other mainly based on understanding processes and methods for organizing effective and efficient learning. TPACK can be interpreted as a form of knowledge which is a synthesis of three content knowledge, pedagogical knowledge, and context knowledge. This concept was further developed into TPACK because of the added technology element. The TPACK model is shown in Figs. The following figure is a TPACK framework with related knowledge components [6].

Technological Pedagogical Content Knowledge (TPACK) is a form of knowledge that transcends all components, namely content, pedagogy, and technology. It is an understanding that arises from the interaction of knowledge, content, pedagogy, and technology. Knowledge of TPACK is a synthesis and integration between ICT in the learning process in the classroom. TPACK knowledge is described as a form of multi integration and transformation [4]. TPACK limits sometimes overlap. These limits classify forms of knowledge. For example, when discussing knowledge related to TPK, such as utilizing online facilities for discussion and searching for references in fulfilling material [7].

There are three main points considered TPACK. There are pedagogical content knowledge, technology content knowledge, and technology pedagogical knowledge. However, in detail, the TPACK sections will be explained as follows [8]:

- a) Content Knowledge (CK) is the knowledge contained in the subject matter to be taught. Knowledge of this content is significant for teachers in the learning process. Content knowledge here is knowledge of concepts, theories, facts, ideas, principles to the framework of thinking. The content will be presented according to the needs to be achieved in learning.
- b) Pedagogical Knowledge (PK) is the knowledge that must be possessed by every educator in the learning process, it will be knowledge of the process or practice of the teacher in delivering content material to be learned by students.
- c) Technological Knowledge (TK) is a knowledge of technology owned by the teacher. Technology is not accompanied by a set of electronic devices such as the use of computers and smartphones as a means of learning media. However, technology here can also be interpreted by the use of books and teaching aids, and other media.
- d) Pedagogical Content Knowledge (PCK). Pedagogical, knowledge, and content are closely related to the knowledge of how teachers teach by the content of the material taught. PCK involves choosing the right method or strategy by the characteristics of the material.
- e) Technological Content Knowledge (TCK) is a knowledge that must be possessed by teachers about the strengths and weaknesses of using a media (both conventional and electronic media) in the learning process. For this reason, teachers are also expected to be able to be familiar with current learning technologies so they can gain broad knowledge about technology.
- f) Technological Pedagogical Knowledge (TPK) is knowledge in improving practical pedagogical abilities about teacher skills in teaching, assessment, and also arousing student motivation to learn. Teachers also need a preliminary study of the need for using technology in learning.

III. METHOD

This research is a descriptive study to describe the need for teaching materials that integrate TPACK in chemistry learning. The method in this study uses survey methods and data collection instruments using a questionnaire. The researcher was taking Samples by purpose sampling with 35 high school students majoring in natural sciences as research subjects. The results obtained are as follows below.

IV. RESULTS AND DISCUSSION

This research is a qualitative descriptive study that describes the findings that are collected, analyzed, and summarized according to the desired research objectives. The researcher was researching to obtain information about the needs of students with TPACK-based teaching materials in chemistry learning. The researcher surveyed by distributing a questionnaire of teaching material needs to

high school students majoring in Natural Sciences. Using a questionnaire for teaching material needs, facilitates researchers in analyzing the main problems faced by students. Data obtained from the questionnaire needs of students are then analyzed descriptively. There are three aspects analyzed, namely (1) the characteristics of students. (2) educator competency analysis, and (3) curriculum analysis.

TABLE 1. THE RESULT OF QUESTIONNAIRE CLOSE

Number	Indicators	Yes (%)	No. (%)
1	Students feel happy about the process of learning chemistry	40	60
2	The process of learning chemistry is still not very interesting	64.5	35.5
3	Teachers are still monotonous in the learning process and there has been no change in learning innovation in accordance with technological progress	77.4	22.6
4	The lack of use of instructional media and the involvement of students in learning chemistry	58.1	41.9
5	The need to use instructional media by integrating teacher skills in learning chemistry	83.9	16.1

The table above shows that 40% of students feel happy about the process of learning chemistry. On the other hand, students feel unhappy or not interested in learning chemistry because learning is abstract (scientific) and difficult for them to understand. 64% of students also feel that learning chemistry in the classroom is still not very interesting. Less attractive chemistry learning can also be a factor that causes students to be less enthusiastic in chemistry lessons, so learning objectives cannot be achieved optimally. It is a challenge for teachers to create learning that can motivate students in learning. Many things must be addressed to produce optimal learning, both from the learning design, presentation of material and teaching materials, and the technology used. In learning between facts, concepts, principles, and procedures must have indicators that are in line [9].

The learning process in the classroom should occur in two directions in order to create an active classroom atmosphere, but 77.4% of students consider teachers to be still slow in the learning process. Monotonous learning makes students feel as if forced to learn; they will feel pressured. This situation will cause students to feel annoyed, bored, and feel indifferent. It causes attention to the interest and motivation of students in learning to below and will have an impact on the achievement of chemistry learning goals and the low learning outcomes of students. A teacher must be able to integrate content knowledge into knowledge about

the curriculum, learning, teaching, and students. This knowledge will lead the teacher to arrange learning situations according to the individual and group needs of students. Such knowledge is expressed as pedagogical content knowledge or called PCK [1]. One of the factors that make it possible to improve the ability of teachers is to enrich PCK, which is a unique blend of content knowledge and pedagogical knowledge that is built over time and experience, to produce professional teachers [10]. The type of knowledge that teachers need to produce optimal learning is content knowledge, technological knowledge, and pedagogical knowledge. Much research has been done on Pedagogical Content Knowledge (PCK). From the various studies, in general, the results of this study indicate that the Pedagogical Content Knowledge (PCK) is essential knowledge for the development of professional skills of teachers and prospective teachers [2] [3] [5] [8].

Success in the learning process is very dependent on the teacher as a facilitator, so to create active learning, the teacher must create a teaching style that is appropriate to the characteristics of the students [11]. The teacher must be competent in subject knowledge, pedagogical skills, and technological knowledge [12]. While the survey found that learning media is still lacking, so students have not experienced changes in learning following technological progress. While we are developing technologies that are improving now, we have developed much learning to achieve the expected learning goals. Technological knowledge is someone who can use hard and soft devices [3]. In recent years technology has played an essential role in turning education into more progressive and interactive activities.

The aspects contained in the 2013 curriculum have still not been implemented correctly. Likewise, between principles, concepts, and facts in learning are still not implemented. The goal of a design is getting the best solution for solving a problem by utilizing some information available. Thus, a design will emerge because there is a need to be able to solve a problem. Through a design, a person can take systematic steps to be able to solve the problem at hand. Judging from the way of teaching teachers who are still monotonous, relying on the lecture method and the lack of media use in the learning process, which means the teacher has not implemented learning in accordance with the demands of 2013 curriculum learning, CTL, PBL, and many more approaches and methods that can be applied by teachers in the learning process.

When technology knowledge is integrated with TPACK elements, TPK, TCK, and TPACK will appear [3]. There are three components of the use of TPACK of teachers in learning, namely: (1) the use of technology to display curriculum information, (2) the second level of students using technology to present content and materials, and (3) developing the ability to use technology to improve teaching skills [13]. In implementing chemistry learning, it is necessary to achieve these three components to create optimal learning.

V. CONCLUSIONS

Based on the results of research conducted, researchers can conclude that the problem in learning chemistry is the lack of use of instructional media that integrates teacher

pedagogy in the implementation of learning. However, according to the results of the study, 83.9% of students need teaching materials that integrate teacher teaching skills to achieve optimal learning. For this reason, it is necessary to develop teaching materials that integrate technology, pedagogy, and content knowledge (TPACK).

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