Technological Pedagogical Content Knowledge of Prospective Mathematics Teacher in Three Dimensional Material Based on Sex Differences

M A Aqib\textsuperscript{1,}\textsuperscript{*}, M T Budiarto\textsuperscript{1}, P Wijayanti\textsuperscript{1}

\textsuperscript{1}Departmen of Mathematics-Universitas Negeri Surabaya, Indonesia Jl. Ketintang, Surabaya 60231
\textsuperscript{*}Corresponding Author. Email: mohammadaqib@mhs.unesa.ac.id

Abstract: The effectiveness of learning in this era can be seen from 3 factors such as: technology, content, and pedagogy that covered in Technological Pedagogical Content Knowledge (TPCK). This research was a qualitative research which aimed to describe each domain from TPCK include Content Knowledge, Pedagogical Knowledge, Pedagogical Content Knowledge, Technological Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge and Technological, Pedagogical, and Content Knowledge. The subjects of this research were male and female mathematics college students at least 5th semester who has almost the same ability for some course like innovative learning, innovative learning II, school mathematics I, school mathematics II, computer applications and instructional media. Research began by spreading the questionnaire of subject then continued with the assignment and interview. The obtained data was validated by time triangulation. This research has result that male and female prospective teacher was relatively same for Content Knowledge and Pedagogical Knowledge domain. While it was difference in the Technological Knowledge domain. The difference in this domain certainly has an impact on other domains that has technology components on it. Although it can be minimized by familiarizing the technology.

1. Introduction
The age of globalization has an impact on everything such as communications, informations and tools that more advanced from the past [1]. This also affects the learning. Learning that was originally using traditional learning system must became a modern learning system or in other words learning must using technology that develops today. In learning teacher should have extensive knowledge of the technology that to be taught, pedagogy skills in classroom management based on technology, and technical knowledge about technology that to be used [2]. In general there are three main factors that affect the effectiveness of learning with technology such as: technology, pedagogy, and materials that to be taught. A knowledge framework that links these three factors in complexly called Technological Pedagogical Content Knowledge (TPCK) [3].

There are seven knowledge domains from TPCK which is a combination of the three bodies components such as: content, pedagogy, and knowledge. The seven knowledge domain are Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technology, Pedagogy and Content Knowledge (TPaCK) [3]. CK is a knowledge about learning materials that to be taught, in this research is math lessons include facts, concepts, principles, and rules [3,4]. PK is knowledge of methods and processes in learning include knowledge about classroom management, assessment, and lesson plans [3,4]. PCK is the knowledge...
of the learning process in terms of the material that to be taught [3,4]. TK is knowledge of a variety in technologies, from low–tech technology to digital technology [3,4]. TCK is the knowledge of how technology can provide a new representation from a particular subject, in this research is math lesson [3,4]. TPK is knowledge about how various technologies can be used in the learning process [3,4]. TPaCK is the knowledge needed by teachers to integrate technology in the learning process for each subject matter [3,4]. Description of each domains knowledge from TPCK and relationship among them can be seen in Figure 1.

In learning, teacher must know the various domains of knowledge contained in TPCK and know the relationship between these domains. Many teachers experience a lack of preparation in using today's technology because they earn a bachelor's degree when technology is more simple than today [3]. This leads prospective teacher who will become teacher have a big role in learning with technology. That because technology will continue to evolve over time. Mathematics is one example of learning that technology’s necessary needed. Technology can become the bridge of abstract thinking in learning mathematics. The three dimensional material is one of the mathematical content area which it called space & shape [5].

One of relevant study is from Jordan entitled 'The influence of gender on beginning teachers' perceptions of their Technological Pedagogical Content Knowledge' which results there are significant differences between male and female beginner teachers. Females rated their knowledge higher than males in one domain that is Pedagogy Knowledge and man rated their knowledge higher than female in six other domains [6]. Data retrieval is done by using closed questionnaire only, so the data obtained only in form of perception and can't describe completely. From that matter, research about TPCK based on sex differences that use qualitative approach in order to get the whole description is urgently needed.

2. Research methods
This research is qualitative descriptive research. Qualitative approach is used so that it produces descriptive data in the form of written or oral words from people and observed behavior. The subjects of this research were mathematics college students at least 5th semester that already thought some course like innovative learning, innovative learning II, school mathematics I, school mathematics II, computer applications and instructional media. The subjects consist of two college students selected based on the criteria that the two students have nearly equal ability and have different sex. Research began by spreading the questionnaire of subject then continued with the assignment and interview.

The instrument in this research is task-based interview guide. The task-based interview guide is used as a directive in the interview to obtain the information that is needed. Task in this research is to create lesson plans with help of technology on three dimensional materials. Meanwhile, the type of interview used in this research is semi-structured that it contains about extracting more information about the task undertaken by college student. The interview was conducted after the college students made the lesson plans based on technology. After the data obtained, validation of the data is using time triangulation with breaks time about three weeks.
Data analysis in this research are data reduction, data presentation, and conclusion [7]. In data reduction, data based on interview is coded according to the indicators, selecting and disposing of unnecessary information. Then the data is classified according to each TPCK domains. In the data presentation, there are a collection of information that arranged systematically so it can be drawn a conclusion. In conclusion, the researcher gives an overview for each domain in TPCK.

3. Results and Discussion
The description of each TPCK domains for prospective teacher based on sex differences are presented in Table 1.

| Domain | Description | Male Prospective Teacher | Female Prospective Teacher |
|--------|-------------|--------------------------|-----------------------------|
| CK     | Give an examples of facts, concepts, principles and rules but memorized in definition so that the definition appeared as an opinion of subject | Explain the detail of three dimensional concepts | Explain the detail of three dimensional concepts |
| PK     | Give an example of various techniques and methods of both cognitively and psychomotorically assessment and its functions | Give an examples of various techniques and methods of both cognitively and psychomotorically assessment and its functions | Explain theoretically about classroom management and learning management | Explain theoretically about classroom management and learning management |
| TK     | Explain the technical about using hardware | Explain the latest of technology and interested in using it | Not explain about the latest of technological development | Give an examples of various types applications but limited when using it | Give an examples of various types applications but felt difficult when using it |
| PCK    | Adjusted the selection of models, methods, and approaches to each other by focusing on the material that being taught | Adjusted the selection of models, methods, and approaches to each other by focusing on the curricula | Represented the three dimensions concepts according to the technology that he used | Can’t applied the representation of facts, concepts, principles and rules with technology that she used in the three dimensions and limited on gave an images |
| TPK    | Maked technology as a reinforcement of concepts in learning of three dimensional learning | Maked technology that is practically and easy to use | Selected technologies that can enhanced student activity | Selected technologies that can enhanced student activeness |
| TPaCK  | Maked technology as a conceptual presenter in three dimensional learning |
Based on Table 1, it describes seven domains of TPCK include CK, PK, TK, PCK, TCK, TPK and TPaCK. It shows that there are similarities and differences between male and female prospective teacher. Based on obtained data, show that for CK and PK domains almost has no differences. For the PCK domain, both male and female prospective teacher is much alike in selection of models, methods, approaches, and related to each other. Slightly differentiate that male students are more concerned with the suitability of the material that to be taught while the female prospective teacher focus more on the suitability of the applicable curriculum.

The big difference between male and female prospective teacher was found in TK domain. This is due to significant differences in terms of gender-related attitudes to ICT, ICT skills, and use of ICT [8]. Male prospective teacher knew various types of applications but limited when using it where female prospective teacher knew the various applications but felt difficult when using it. Here it is seen that male prospective teacher are indirectly more able to use computer applications than female prospective teacher. Female prospective teacher have difficulty in using computer applications, unlike male prospective teacher although their use is still limited in basics. This is because both men and female have significant differences in ICT skills with male have higher scores than female [9]. Differences in TK domain certainly have an impact on other domains that have technological components such as TCK, TPK, and TPaCK.

In TCK domain, male prospective teacher can represent concept of the three dimensional material according to the technology that used while the female prospective teacher are less able to apply the representation of facts, concepts, principles and rules on the three dimensional according to the technology that used. This is certainly not separated from the technology that they used, geogebra selected by male prospective teacher is easy in represent the concept compared to technology namely power point that used by female prospective teacher [2].

In TPK domain, male prospective teacher choose technology that is effectively and efficiently in terms of learning design while female prospective teacher choose technology that is practical and easy to use. In contrast to male prospective teacher, female prospective teacher feel unable to use geogebra so that she used power point which in fact it is the application that she mastered. There are an indication that female teachers have low self-confidence in using ICT in learning compared to male teachers [10]. The same is also on TPaCK domain where male prospective teacher utilize technology as a reinforcement concept in the learning of the three dimensional material while the female prospective teacher utilize technology only as the presentation of the material in learning three dimension material.

The big difference between male and female students in terms of technology can actually be minimized. As it can be seen that male and female prospective teacher can overcome technical problems related to computers. This happens because the use of laptops and LCD have become common place in education. It can be concluded that the difference of knowledge about technology between male and female prospective teacher can be minimized if the technology has been frequently used. The more and more computers are used in schools it will reduce the effect of differences in use between male and female [11].

4. Conclusion
Based on the result of the research, male and female prospective teacher candidate students are the same for the CK and PK domain. In the TK domain, male prospective teacher knew various types of applications but limited when using it where female prospective teacher knew the various applications but felt difficult when using it. In the PCK domain, male students are more concerned with the suitability of the material that to be taught while the female prospective teacher focus more on the suitability of the applicable curriculum. In the TCK domain, male prospective teacher knew various types of applications but limited when using it where female prospective teacher knew the various applications but felt difficult when using it. In the TPK domain, male prospective teacher choose technology that is effectively and efficiently in terms of learning design while female prospective teacher choose technology that is practical and easy to use. Last in the TPaCK domain, male prospective teacher utilize technology as a reinforcement concept in the learning of the three dimensional material while the female prospective teacher utilize technology only as the presentation of the material in learning three dimension material.
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