Pedagogical content knowledge (PCK) profile of prospective teachers in mathematics learning

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Abstract: Pedagogical Content Knowledge (PCK) is a blend of understanding teaching material (content knowledge) and understanding of ways to educate (pedagogical knowledge) that need to be possessed by a teacher. The purpose of this study was to find out the profile of the Pedagogical Content Knowledge (PCK) of prospective teacher students, knowing the role of prospective mathematics teacher students towards PCK. This research is a qualitative study that describes the ability of PCK students of mathematics teacher candidates. A teacher in carrying out his professional duties must have competence that is always maintained. Therefore, competency development is an important requirement to ensure that the quality of learning in the class adapts to the development and demands of the times. Competence that is always maintained also ensures that the implementation of education is consistent in achieving educational goals. There are ten PCK criteria that must be possessed by prospective teacher students before practicing in the field. Teacher candidates must also be able to implement learning, knowledge about ways to represent and explain a material to make the material understandable to others.

1. Introduction

Student learning outcomes in the form of learning achievement is a product of quality learning facilitated by the teacher. In managing quality learning requires comprehensive teacher knowledge. Teaching and learning activities are the embodiment of teacher knowledge in the classroom. Teacher's knowledge determines the quality of a teacher, which in turn affects the achievement of student learning outcomes [1]. There are five basic types of learning to provide quality education and foster sustainable humanity, namely learning to know, learning to be, learning to live together, learning to do, and learning to transform oneself and society [2].

Shulman proposed the idea of Pedagogical Content Knowledge to answer "what knowledge should the teacher have?" [3]. Research and colleagues show that knowledge of pedagogical content is the main determinant of teacher success in learning. Knowledge of pedagogical content is an embodiment of knowledge of content and pedagogical knowledge.
Knowledge of pedagogical content of mathematics teachers has often been the subject of research [4,5]. The results of Hill's research, [6] show that there is a very close relationship between teacher knowledge and student mathematics learning achievement. The results of the study of [7] show similar things, knowledge of pedagogical content of mathematics teachers has an impact on more effective learning.

The Indonesian government realizes the importance of teacher competence in achieving quality education. Therefore, the government sets out four competency standards that must be met by the teacher. Law Number 14 of 2005 concerning teachers and lecturers requires pedagogical, professional, personal and social competence. The four competencies must be fulfilled by the teacher while being a teacher. Therefore, these four competencies are the requirements and references in recruiting and developing teacher competencies. The description of the four competencies is described in Minister of National Education Regulation Number 16 of 2007 concerning teacher competency standards.

A teacher in carrying out his professional duties must have competence that is always maintained. Therefore, competency development is an important requirement to ensure that the quality of learning in the class adapts to the development and demands of the times. Competence that is always maintained also ensures that the implementation of education is consistent in achieving educational goals.

According to [8] Professional development is a learning experience both acquired naturally and through conscious and planned activities and contributing to improving the quality of learning in the classroom. Professional teacher development greatly determines the quality of learning in the classroom. The government realizes the importance of teacher professional development in a sustainable manner. So it was published (Permennegpan R B Number 2009 which places continuous professional development as a major component of teacher career development. A professional teacher is not only obliged to carry out teaching and learning tasks in the classroom, but also responsible for developing his profession in a sustainable manner.

2. Methods
This type of research is qualitative research [9] state that qualitative research is meaningful to the meaning of individuals or groups as a social or human problem. The method used in this study is the description method. Descriptive research aims to describe events that occur in the present. The method used in this research was the description method. Descriptive analysis was done by recording data, data presentation, drawing conclusions, and verification. The results of the study were obtained from data obtained from 4 prospective teacher students who were given tests and interviews by researchers. The discussion in this study was carried out conceptually, that is based on the reference theory used.

3. Discussion
3.1. Pedagogical Content Knowledge
Teaching is a complex task, in carrying out it requires adequate competence. Therefore, in carrying out his professional duties a teacher needs to be supported by a set of abilities or competencies. Knowledge or competence is a combination of mastery of material and mastery of how to teach. Knowledge about the integration of material knowledge into knowledge about curriculum, learning and student characteristics, hereinafter known as Pedagogical Content Knowledge, or in Indonesian is better known as pedagogical content knowledge [10].

The term Pedagogical Content Knowledge (PCK) or knowledge of pedagogical content was first introduced. Lee Shulman through his research community collaborated on the Knowledge Growth in
Teaching (KGT) project. This research project examines the knowledge that teachers must have in developing learning. This knowledge includes knowledge about content and knowledge about how to teach. Shulman uses the term Pedagogical Content Knowledge (PCK) as a combination of three teacher knowledge, namely: knowledge of subject matter, knowledge of pedagogical, and knowledge of context [11].

Shulman put forward the idea of pedagogical Knowledge Content to answer "what knowledge should the teacher have?" [12]. At that time there was an understanding that material knowledge (subject matter knowledge) and knowledge of teaching methods (pedagogic knowledge) were the main determinants of teacher success in teaching. The results of Shulman's research and colleagues show that Knowledge of pedagogical content is the main determinant of teacher success in learning. However, knowledge of pedagogical content cannot be separated from knowledge of content and pedagogical knowledge.

According to [13] Knowledge of pedagogical content is an academic construct that describes an idea that can arouse interest in learning something. [14] in his study suggested that there were three knowledge that must be mastered by the teacher, namely conceptual knowledge, knowledge of material structure, and knowledge of specific context orientation in teaching.

Argues that Knowledge of pedagogical content consists of: (1) knowledge of ways to present and explain a material to make the material understandable, (2) knowledge of students' thinking, especially knowledge about conceptions, and preconceptions of students who different ages and backgrounds they bring into learning and (3) PCK also includes an understanding of what makes learning about a particular topic easy or difficult.

Some aspects of PCK were identified as a model of pedagogic reasoning in fact, development, application, and communication that shows the interrelationship with each other. Existence from the above definition, PCK is knowledge which is a combination of content and pedagogic knowledge in understanding topics, problems or issues and how the integrated knowledge is organized, so that it can be adapted from a variety of students' abilities and interests which are then implemented in learning, knowledge about ways to represent and explain a material to make the material available understood by others.

Some researchers use Shulman's ideas to study teacher knowledge in various fields of study, including mathematics, for example [15,16,17], and others. The results of the study were synthesized and developed by Ball and Bass to study the work of teaching mathematics from a mathematical point of view. Their research was conducted by studying the results of the Ball's teaching record for one year, including student work results and teacher notes.

PCK is knowledge about what, when, why and how to teach using good knowledge about practice and teaching experience. So that PCK can be described as follows:
Related to the Pedagogical Content Knowledge (PCK) which consists of the content knowledge and pedagogical knowledge that should be owned by a teacher, the government of the Republic of Indonesia has actually arranged this through PP No. 17 of 2008. This knowledge content according to PP No. 74 of 2008 is the professional competence of teachers which is a teacher in mastering the knowledge of the fields of science, technology, art and culture which at least includes mastery of subject matter widely and deeply in accordance with the standard content of educational units, subjects and subject groups who will be taught, concepts and methods of scientific discipline, technology or relevant arts that are conceptually overshadowing or coherent with educational unit programs, subjects, subject groups to be taught.

The pedagogical knowledge according to PP No. 74 of 2008 is the teacher's pedagogical competence, which is the learning management ability of students which includes at least understanding insight or educational foundation, understanding of students, developing curriculum / syllabus, learning design, implementing learning that is educational and dialogical, utilizing learning technology, evaluation of learning outcomes, and development of students to actualize the various potentials they have. This shows that the government of the Republic of Indonesia has been very serious about improving education in their country so they can compete with other countries.

3.2. Pedagogical Content Knowledge Prospective Teachers in Mathematics Learning

The results of the study with several prospective teacher students indicate that there are still prospective students who have not mastered the knowledge of pedagogical content, because each teacher must have knowledge of pedagogical content. A teacher besides being able to master the material must also have a pedagogy to teach his students. Likewise vice versa if possessing pedagogical knowledge of a teacher must also master the content of the material to be taught.

When researchers give problems to prospective teacher students related to PCK. "Consider the following problem: The result $\sqrt{21} + \sqrt{3} + \sqrt{1}$ is .... Your students work in the following way: Results of
\sqrt{21 + 3} + 1 = \sqrt{25} = 5 \quad \text{Using this method, it is possible for your students to experience learning difficulties caused by ...}''

The answers from prospective teacher students varied, some answered that the students did not understand the addition of roots, there were also those who answered that the students did not know the operating properties of the irrational form. From these answers indicate that prospective teacher students only answer questions from the content side only, do not show how pedagogical knowledge.

Mathematics learning is expected to encourage students to think logically, analytically, systematically, critically, creatively and the ability to cooperate effectively. If a teacher wants students to have the ability to think creatively, then a teacher must also have the ability to think creatively. Here what will be seen is how a creative teacher in the learning process is seen from the knowledge of the teacher's pedagogical content.

The results of research with prospective teacher students have been conducted to determine the pedagogic content knowledge capabilities. The student is given the question "How to know the potential of students in the subjects they are teaching?". Each student of the prospective teacher gives different answers and reasons, one of the answers they give is to find out the potential of the students if they have been able to solve the problem so that the students can be categorized as intelligent. From these answers, it can be seen that the pedagogic content knowledge ability of prospective teacher students must still be given direction and understanding.

The results of interviews with prospective teacher students there is one student who still masters learning theory well, in order to master this learning theory well to be applied in the learning process. Using appropriate learning theories to apply in the learning process can produce good learning processes. And prospective teacher students also have appropriate learning strategies tailored to the material being taught. The choice of strategy also influences student learning success. Thus the prospective teacher student has quite good pedagogical content knowledge skills. Therefore the writer wants to examine more deeply the pedagogical content knowledge abilities of the prospective teacher's students.

Revealed how prospective teacher students can develop their PCK to provide enormous benefits, both in relation to research and practice. To do so, prospective teacher students need to recognize and understand the complexity of teaching and then transform their knowledge into easier-to-use forms of teaching [18].

4. Conclusion

The term Pedagogical Content Knowledge (PCK) or knowledge of pedagogical content was first introduced through his research community collaborated on the Knowledge Growth in Teaching (KGT) project. This research project examines the knowledge that teachers must have in developing learning. This knowledge includes knowledge about content and knowledge about how to teach. Shulman uses the term Pedagogical Content Knowledge (PCK) as a combination of three teacher knowledge.

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