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# Pedagogical Content Knowledge Pre-Service Mathematics Teacher

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**Abstract** Content knowledge and pedagogical knowledge are two most important aspects of teaching. Therefore, this research is motivated by the importance of pedagogical content knowledge for pre-service teacher students. The purpose of this study is to analyze PCK that is owned by pre-service teachers when teaching quadrilateral material. The method of this study is a qualitative carried out to obtain an in-depth picture of the pre-service teacher's PCK in the process of learning activities. The sample of this study is taken by 3 students of mathematics teacher candidates who conducting field practice in a junior high school. The instruments of this study are in the form of questionnaires and observation sheets to analyze PCK of teacher candidates, pre-learning questionnaires are used to analyze pre-service teachers in making learning plans as many as 6 indicators, and questionnaires in-learning are used to analyze PCK of teacher candidates in delivering material, mastering concepts and choosing methods in line with 20 Indicators. Based on the data analysis, it was found that the PCK of pre-service teacher students in the quadrilateral material belonged to the classification good enough in developing strategies, making lesson plans, in the learning process and mastery of concepts.

## 1. Introduction

Teacher is one of the factors that determine the success of one's learning. Therefore, the teacher must have good teaching skills and extensive mastery of the material. The ability to make learning plans to carry out learning in class is commonly called pedagogical knowledge, while knowledge about the material to be taught is usually called content knowledge. Combination between pedagogical and content knowledge is called pedagogical content knowledge (PCK). Teachers who succeed in teaching are those who have good pedagogical knowledge and content knowledge. That is the expectation and achievement that must be achieved by each teacher.

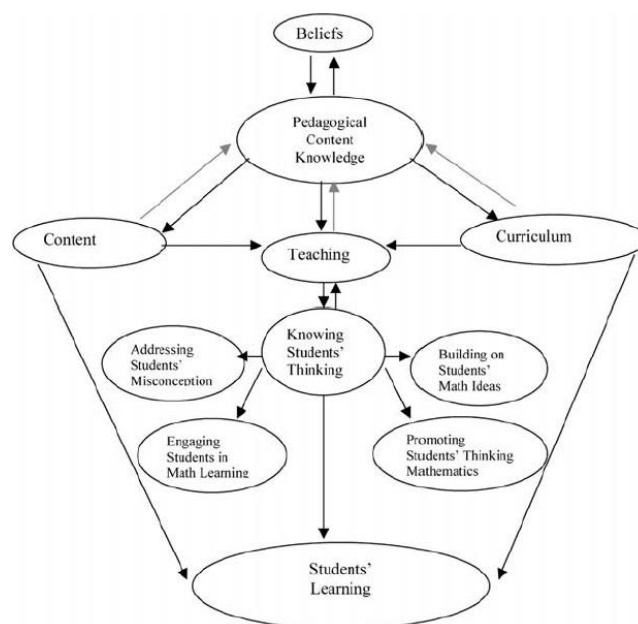
Pedagogical ability is not obtained suddenly, but it is obtained through continuous and systematic learning efforts, both in pre-service teacher education period and teaching profession. This pedagogical ability is influenced by several things; among of them are talents, interests and other potential of every individual concerned. Pedagogical ability includes the ability to plan and carry out learning and evaluate learning outcomes [1]. So, pedagogical knowledge is a teacher's skill that must be developed to manage and regulate learning and teaching activities in order to achieve learning outcomes as expected [2]

The preparation of the learning plan includes formulating objectives, describing the description of the discussion unit, designing teaching and learning activities, choosing various media and learning resources, and planning assessment of mastery of objectives. Carrying out the teaching and learning process includes: opening lessons, presenting material, using media and methods, using teaching aids, using communicative language, motivating students, organizing activities, interacting with students



communicatively, concluding lessons, giving feedback, carrying out judgments, and using time effectively [3]

Knowledge of content or material is obtained by pre-service teachers since from elementary school to college. When attending pre-service teacher education in higher education, the teacher candidates receive courses specifically discussing the concepts learned at school so that knowledge about their material can be honed. The following is PCK networks illustrating that teaching knowledge, material knowledge, and curriculum are interrelated and influence each other.



**Figure 1.** The Network Of Pedagogical Content Knowledge [4]

In figure 1 on this network, three types of knowledge interact each other and are able to transform from one form to another around the main task of teaching. In the end, these components improve student learning outcomes.

Mathematics is a subject that students often avoid [5]. Therefore, being a teacher of mathematics is not an easy thing to do; special expertise is needed in teaching mathematics because in mathematics the ability to reason in the process of thinking is really needed [6]. Creating effective teaching can be done by presenting an interesting, systematic and coherent learning and that is within the framework of PCK

In addition, a professional teacher must master seven aspects, namely: knowledge of mathematical material, general pedagogic knowledge, knowledge of pedagogic content, curriculum knowledge, learning knowledge and characteristics, knowledge of teaching strategies, and knowledge of learning contexts [7]. These seven capabilities are broader and more detailed than PCK, but basically, they are already covered by PCK.

Based on the results of research, many mathematics teacher candidates still have low PCK [8], or in some cases, they excel in mastering the material, but their pedagogical knowledge is low, so the material they mastered is not conveyed well to students, or vice versa, we can see teachers with good pedagogical knowledge but low mastery of the materials; so, it is clear that both cases are not expected.

Education for pre-service teachers is important in developing PCK. One of the higher education institutions producing pre-service teachers is IKIP Siliwangi, several subjects are designed to improve teaching skills and ability to master the material. Before entering teaching field as teachers with Program Field experience, the student teachers practice teaching in schools for 3 months. This program aims to train them to teach and develop their pedagogical abilities. At the end of the program there will be an assessment of the appearance of students when teaching by a supervisor.

In this study, the researchers take 3 samples of students, who are carrying out teaching practice, to analyze their PCK as student teachers of mathematics by assessing how they plan and carry out learning

and conduct learning assessments. The material chosen is quadrilateral. It is chosen because it is a fundamental material in understanding other geometry, for example students usually find it difficult to study the three dimensions because the concept of quadrilateral flatness is still lacking. Based on the explanation of the problems described above, this study aims to analyze the Pedagogical Content Knowledge that is owned by mathematics education teacher candidates

## 2. Method

Method used in this study is descriptive qualitative method. It is chosen because the researchers want to describe the facts regarding the pedagogical knowledge content of prospective mathematics teachers. The samples of this study are 3 students of IKIP Siliwangi implementing field observation program in 2018 in junior high school. The instrument of this study is a Likert scale questionnaire which will be strengthened by the observation sheet and interview guidelines. Observations are made on pre-learning and during learning in class. In Pre-Learning, the researchers observe the learning design (learning scenario) made before the students perform teaching, the instruments used are 6 items of indicators, to measure the feasibility of the learning scenario, then the researchers observe the teaching process of 3 students on the quadrilateral material. The Likert scale questionnaire used is adopted from the framework for analyzing PCK made by [9] which contains: Selection of appropriate strategies and models, Describing misconceptions that occur in students, reading the way students think in understand a concept, conveying the purpose of learning, connecting material with the real world, identifying tasks that are difficult for students, using appropriate learning resources, using models and teaching aids, mastery of material concepts to be taught, connecting concepts to other topics.

## 3. Result and Discussion

In this section, we will explain about the results of observations in learning brought by 3 mathematics student teachers on the quadrilateral topic. Observations made are pre-learning and when learning takes place. In pre-learning the elements observed regarding the making of planning learning will be carried out. The following will be presented in the pre-learning assessment in table 1.

**Table 1.** Results of PCK Assessment in Pre-Learning

No	Aspects of Assessment	M1	M2	M3	Mean
1	Clarity of Learning Objectives Formulation	3	4	4	3,7
2	Organizing teaching materials (coherence, material systematics, and appropriateness of time allocation)	4	4	4	4
3	Clarity of the learning scenario from the initial activity to the final activity	3	4	5	4
4	Detail of Learning Scenarios, at each step there is a strategy / method and time allocation	3	3	4	3,3
5	Suitability of learning methods with material	4	4	4	4
6	Completeness of assessment instruments	4	3	3	3,3

Notes:

1 : Very low

2 : Low

3 : Moderate

4 : High

5 : Very High

We can see in table 1 that Students' PCK in pre-learning, namely in making learning planning for all indicators classified as Medium. The highest mean of indicator is a systematic scenario, clear, and learning methods used in accordance with the material to be delivered. Learning scenarios that are made greatly affect the appearance of teachers in learning in class; where mature lesson plans learning in the classroom will run effectively, so that learning objectives will be achieved. Teachers who have pedagogical competence in terms of good lesson plans tend to develop lesson plans according to the situation and conditions of students [10].

**Tabel 2.** Results of PCK Assessment during In-Learning

No	Aspects of Assessment	M 1	M 2	M 3	Mean
1	Explaining learning objectives related to quadrilateral material	3	4	5	4
2	using proper strategies or approaches to teach quadrilateral concepts	5	4	4	4,3
3	Demonstrating Mastery of Quadrilateral Material	3	3	3	3
4	Identifying students' particular ways of thinking about quadrilateral concepts	4	3	3	3,3
5	Identifying certain students who have misunderstandings about the concept of Quadrangle, then giving an explanation	3	3	3	3
6	Identifying tasks that students feel are difficult to do	4	3	4	3,7
7	Demonstrating the concept of inner quadrilateral form of modeling or illustrating in overcoming conceptual errors	3	4	3	3,3
8	Using proper learning resources	4	4	3	3,7
9	Discussing why the content was included in curriculum or how to use it	3	3	3	3
10	Linking quadrilateral concepts to knowledge possessed by students	1	1	2	1,3
11	Providing motivation to students so that the emergence of reciprocity in learning activities takes place	4	4	3	3,7
12	Linking material learned with everyday life	3	3	3	3
13	Linking material learned with other material concepts related to quadrilateral concepts	3	3	3	3
14	Performing skills for solving mathematical problems	4	3	5	4
15	Implementing interesting learning activities, so students are interested and focused on learning	3	3	3	3
16	Using good and correct written language	3	3	4	3,3
17	Monitoring learning progress during the Learning Process	3	3	4	3,3
18	Reflecting or making a summary by involving students	3	3	3	3

19	Follow up by providing direction, or activities, or assignments as part of remedies / enrichments	3	4	5	4
20	Conducting Final Evaluation in Accordance with Competency	3	4	5	4

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Notes:

1 : Very low

2 : Low

3 : Moderate

4 : High

5 : Very High

Observation during learning is done to analyze PCK of the three mathematics teacher candidates, the results can be seen in table 2. Of the 20 indicators assessed, there is only 1 indicator categorized into the less criteria, namely indicators Linking quadrilateral concepts to the knowledge possessed by the students. Even though this indicator is very important in forming quadrilateral concepts, by relating concepts to the knowledge possessed by previous students, the students will learn meaningfully. Meaningful learning will be remembered in the long-term memory of students and get stronger in their minds. With the strong information attached to the memory of students, it will certainly have an impact on the acquisition of student learning outcomes [11]

Apart from that, overall the third PCK of the three mathematics student teachers can be said to be Good, this can be seen from 19 indicators categorized as the criteria quite well. The indicator with the highest mean is the selection of strategies and learning approaches that are in accordance with the material being taught. This is very important for a teacher, with a suitable learning approach; the material will be conveyed well. The approach used by student teachers 1 is a contextual approach; starting from contextual problems, he constructs definitions and quadrilateral properties, thus the participants understand quadrilateral concepts better because in contextual learning the student teacher introduces material using a variety of active learning techniques designed to help the participants connect what they already know and to build new knowledge from analysis and synthesis of the learning process [12].

The student teacher 2 uses a scientific approach in teaching quadrilateral; the participants appear to be more active and creative to develop ideas. This approach is appropriate because the activities developed in the scientific approach can lead to the emergence and creation of various learning experiences obtained by the participants through involving all the five senses, physical, and psychological of students so as to help develop a variety of potential they have [13]. The student teacher 3 uses a realistic approach in teaching quadrilateral, well-structured steps of realistic learning starting from using context, using models, using student contributions, interactivity and interrelationships between topics presented by the teacher well, so that Mathematics is more interesting, relevant, and meaningful, not too formal and not too abstract [14]

In addition to using appropriate learning approach, the three student teachers are able to master the quadrilateral concept so that the material can be delivered well. It can be concluded that in addition to good pedagogical knowledge, the three student teachers have good content knowledge. A professional teacher must have and know the capabilities of the PCK they have. Good PCK has an impact on the achievement of concepts and increasing students' teaching abilities [15]. From the above explanation we can analyze that Pedagogical Content Knowledge (PCK) is an important professional skill in developing teacher skills in teaching.

#### 4. Conclusion

Based on the results of data analysis and discussion, it can be concluded that Pedagogical Content Knowledge of the three teacher candidates in delivering quadrilateral material are classified as fairly good. PCK is a professional ability that is important and must be developed by teacher candidates. Therefore, universities creating student teachers must increase the students' PCK by giving training through micro teaching or a course specifically training pedagogical skills for teacher candidates.

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