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*by* Nendra Dwipa

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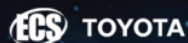
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## **PCK (*Pedagogical Content Knowledge*) profile of mathematics education students at Universitas PGRI Yogyakarta**

**B Wicaksono and N M S Dwipa**

Mathematics Education, Universitas PGRI Yogyakarta

Email: [bintang@upy.ac.id](mailto:bintang@upy.ac.id), [ndwipa@gmail.com](mailto:ndwipa@gmail.com)

**ABSTRACT.** The aim of this research was to analyze the Pedagogical Content Knowledge (PCK) of mathematics education students at Universitas PGRI Yogyakarta. PCK is a representation of the teacher's Pedagogic and Professional abilities. The subjects of this study were students of the Mathematics Education undergraduate program Universitas PGRI Yogyakarta semester VI. Research data were obtained through a questionnaire instrument in the form of a Content Representation (CoRe) questionnaire accompanied by documentation. The analysis was carried out by means of a qualitative descriptive method by observing each answer and classifying each answer to determine the PCK level of Mathematics Education students at PGRI Yogyakarta University. The results showed that, in general, mathematics education students at the PGRI Yogyakarta university were still at the Pre PCK level, seen from the analysis of the objectives, concepts and pedagogical aspects. This is an indicator that it is necessary to develop modules that can facilitate students in developing PCK capabilities.

### **1. Introduction**

The teacher is someone who has the authority and responsibility in educating students [1]. According to Law Number 14 of 2005 concerning Teachers and Lecturers, Teachers are professional educators with the main task of educating, teaching, guiding, directing, training, evaluating, and evaluating students in early childhood education through formal education, basic education, and education intermediate. In the law, it is clearly said that the teacher is a Professional Educator so that a teacher is required to have the ability as a professional. Work is professional if the work can only be done by people who are specifically studying and ready for the job, not those done by people who don't or don't know it yet [1].

Professional teachers must have 4 competencies, namely pedagogic, personality, social, and professional competencies [2]. Shulman studied the characteristics of teachers' knowledge and the professional teachers must possess certain competencies to be called effective [3]. The demand for teacher professionalism is currently strengthened by the government's efforts to hold the Teacher Competency Test or UKG.

UKG is an examination of the mastery of two compulsory competencies of a teacher, namely pedagogical competence and professional competence in the cognitive realm as the basis for determining sustainable professional development activities and part of teacher performance appraisal. Competencies that are tested in UKG are often also known as Pedagogical Content Knowledge (PCK).



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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. From the above explanation, we can analyze that Pedagogical Content Knowledge (PCK) is an important professional skill in developing teacher skills in teaching [4].

PCK is a combination of two competencies, namely pedagogical competence and Content Knowledge competency [5]. Knowledge content, in this case, refers to the professional competence of a teacher where the teacher is required to have the ability to master the knowledge of the fields of science, technology, and/or arts and culture that he supports [5]. PCK is very important owned by an educator to create good learning in the classroom and create meaningful learning for students [6]. As a competency that is very important for teachers, it automatically becomes an important thing that is also owned by prospective teachers who will later continue the teaching process.

Shulman explains Teachers need the knowledge to transform the content into the representative form, which is believed to be able to help the students to improve their competence [7].

As prospective teachers, mathematics education students must also have the competence to support to become professional teachers. The competency must be visible and already possessed even though it is not yet at the perfect stage. Two competencies that support prospective teachers, namely students becoming a professional teacher, are pedagogical competencies and professional competencies. Therefore it is interesting to find out how far mathematics education students have these competencies. The competencies referred to hereinafter referred to as PCK.

## 2. Research Methods

This research is qualitative research. Qualitative research is research aimed at analyzing and understanding conditions or phenomena that occur in the subject under study [9]. The research data were obtained using a Content Representation (CoRe) essay, documentation, and interviews on the subject. The CoRe is a questionnaire in the form of Essay filled in by respondents to find out facts about students that need to be known, namely about Pedagogical Content Knowledge (PCK). The CoRe contains 9 questions about Formulation of Purpose, Concept Selection, The Importance of a Concept, Depth and Extent, Predicted Difficulties in Teaching, Teaching Strategy, Teaching Considerations, Organizing the Material, and Measurement of Student Ability that lead to 3 aspects (Purpose, content, pedagogic). The 9 questions are further grouped into 3 important aspects in PCK categorization, namely the aspects of objectives, content, and pedagogic [10].

The analysis results from 3 aspects (Purpose, Content, Pedagogic), PCK are categorized into 3 level categories. Pre PCK, Growing PCK, and Maturing PCK level categories. The three categories are explained in more detail in the table below [10]:

**Table 1.** PCK level based on aspects of Purpose, Content, and Pedagogic

Aspect	Level PCK		
	Pra PCK	Growing PCK	Maturing PCK
<b>Purpose</b>	Able to set goals but not in accordance with the competencies set in the curriculum	Able to set goals to achieve competencies and concepts taught according to the competencies set out in the curriculum	Able to set rational goals based on the material and needs of students and be able to adjust to the competencies set in the curriculum
	Able to formulate goals but have not accurately described the competencies to be achieved	Being able to formulate goals and be able to accurately describe the competencies to be achieved	The objectives to be achieved are more accurate and flexible according to the competency

			of the learning experience provided.
<b>Concept</b>	Some important basic concepts taught to students are still less relevant to the material, the concepts that appear are still in the form of attributes / sub-points of the material so that the concepts that emerge are still very much	The basic concepts of the material taught to students already refer to/are related to the core concepts and are relevant to the material	Important basic concepts of the material taught to students are the main concepts that are inclusive and are related to several other concepts both at the core material and other material.
	Not yet able to determine the breadth and depth of the material to be taught to students. The depth and breadth of the material refers to general concepts so it is not clear the depth and breadth for each core concept being taught	It can set clearer limits on the breadth and depth of the material being taught. The depth and breadth of the material refers to the core concepts	The breadth and depth of the material are more accurately related to the core concepts that will be taught and consider the needs of students
<b>Pedagogy</b>	The teaching strategies used are still common to all dimensions of knowledge on the material	Align the learning strategy with the characteristics of each dimension of knowledge on the material and competencies to be achieved	Can change the learning strategy based on the conceptual characteristics considerations in each dimension of knowledge and competencies to be achieved besides the teacher can utilize the moments that exist
	The order in which they are presented is in the order of the material in the book	The order in which the material is presented takes into consideration the order of the material in the book and the methods/stages of the teaching model	The order of presentation of the material is more flexible related to the results of material analysis, teaching strategies, and students' needs
	Measuring student understanding by using evaluation tools in general, is still limited to written tests	Using written tests, the instruments developed consider each concept	Use more creative assessments, be able to develop their own assessments according to the analysis of the material provided, students' conditions, and relevant methods so that they are right on target

The subjects of this study were students of the Mathematics Education undergraduate program PGRI Yogyakarta Yogyakarta semester VI. The data obtained were analyzed qualitatively by data triangulation so that the right conclusions were obtained.

### 3. Results and Discussions

#### 3.1 Results

**Table 2.** Summary of the Content Representation (CoRe) questionnaire results

No	Aspect	General Description of Student Ability
1	Formulation of Purpose	Most of the students, namely 6 students, wrote the concept in accordance with the existing curriculum standards. But there are still many students namely 15 students have not written the concept according to applicable curriculum standards
2	Concept Selection	Students are able to choose and determine important concepts for students to learn. However, the concept determined is still incomplete
3	The Importance of a Concept	15 students have not been able to see the relationship between the material and the material being taught, but 15 students have understood the importance of a concept/material in daily life. While 4 other students only saw the importance of the concept of relevance to the next material without seeing the importance of the material in daily life. Only 2 students related the importance of material connection and daily life
4	Depth and Extent	Students have been able to determine the depth and breadth of the material being taught. Students know the material or subject that goes beyond the limits of students' abilities
5	Predict difficulties in teaching	Students still have difficulty predicting the problems they will face related to the material/concepts to be taught. This also indicates that students have difficulty predicting misconceptions or errors in understanding concepts by students.
6	Teaching strategy	Students still have not demonstrated the ability to flexibly determine good teaching strategies.
7	Teaching Considerations	Consideration of teaching students is still in general and only based on students' initial ability to master the prerequisite material.
8	Organizing the Material	11 Students are still experiencing difficulties in compiling / organizing concepts to be taught. The student is still fixated on the composition of the material in the book.
9	Measurement of Student Ability	In measuring the ability of students, students still use 1 or 2 types of assessment only. Students have not used the assessment in accordance with the learning method used.

The table above is the summary of the CoRe questionnaire that has been filled out by students. The results above show a general picture of PCK Mathematics Education Students at Yogyakarta PGRI University. Pedagogical Content Knowledge (PCK) in the CoRe questionnaire was arranged in 9 aspects, namely Formulation of Purpose, Concept Selection, The Importance of a Concept, Depth and Extent, Predicted Difficulties in Teaching, Teaching Strategy, Teaching Considerations, Organizing the Material, and Measurement of Student Ability.

#### 3.2 Discussion

The PCK profile of mathematics education students at PGRI Yogyakarta University can be analyzed by looking at table 1. Based on table 1, we can analyze and map into 3 aspects to find out the level of PCK students' abilities [10]. These aspects are:

##### 3.2.1 Aspect of Purpose

Aspects of the objectives are clearly seen in table 1 namely in number 1 about the formulation of objectives. Most of the students, namely 6 students, wrote the concept in accordance with the existing curriculum standards. But there are still many students namely 15 students who have not written the concept according to applicable curriculum standards. In the summary of the results

of the CoRe questionnaire, the fact is that students have not formulated learning objectives in accordance with the established curriculum. The learning objectives have not been arranged properly by taking into account the competencies to be achieved, but they are still based on the material taught in the guidebook. Based on the results of the CoRe questionnaire, the aspects of mathematics education student goals as teacher candidates are still at the Pre PCK level. Pre PCK level means that prospective mathematics teacher students are able to formulate learning goals but are not in accordance with the established curriculum. In addition, at this level, it also means that prospective mathematics teacher students are able to formulate goals but have not accurately described the competencies to be achieved. It can be concluded that the Pre PCK level provides an illustration that students as teacher candidates are still in the early stages of interaction between pedagogy and content knowledge so there is no incision/integration between the two [10].

This aspect of the goal is actually important to have a teacher, where the teacher must be able to determine the goals to be achieved by students and adjusted to the competencies required by students. With clear objectives and leads to expected competencies, and in accordance with the curriculum, the direction of learning becomes clear and directed [11].

### 3.2.2 *Concept Aspects*

Concept aspects can be seen in table 1 which is divided into three questions namely Concept Selection, The Importance of a Concept, and Depth and Extent of the concept. The first question on the CoRe questionnaire to find out the concept aspects of prospective mathematics teacher students' college at PGRI Yogyakarta University is about the choice of concepts in certain materials. In this question, college students are able to choose and determine important concepts for students to learn. However, the concept determined is still incomplete.

The next question in the Core questionnaire to find out the concept aspects of college students is to find out whether college students understand the importance of a concept to be taught and studied by students. This question leads to the ability of students to understand a concept, whether the concept is important that needs to be taught, and what the concept has to do with daily life. Based on the results of the Core questionnaire, 15 college students have not been able to see the relationship between the material and the material being taught, but 15 college students have understood the importance of a concept/material in daily life. While 4 other college students only saw the importance of the concept of relevance to the next material without seeing the importance of the material in daily life. Only 2 college students related to the importance of material connection and daily life.

The last question is a college student's knowledge about the depth and breadth of a material or concept being taught. How far college students as prospective teachers know the limits about the material and concepts that must be taught to students. This knowledge is important for prospective teachers because by knowing the limits of the depth and breadth of the material being taught, prospective teachers know which concepts are appropriate to the ability of students at the level they should be. Based on the results of the Core questionnaire, Students have been able to determine the depth and breadth of the material being taught. Students know the material or subject that goes beyond the limits of students' abilities. Determination of the depth and breadth of a concept that will be taught to students is the next important thing in the aspect of the content. Table 1 shows students are able to determine the depth and breadth of concepts well. College students have a good knowledge of the materials that can be taught by students and materials/concepts that are beyond the ability of students to learn.

Based on 3 aspects of the CoRe questionnaire in Table 1, the level of PCK students can be categorized as at the level of Growing PCK. Growing PCK is a level where college students as prospective teachers begin to be able to integrate content and pedagogy so that slices have begun

to form between content and pedagogy [10]. In other words, college students with the PCK Growing level have been able to determine the core concepts that are relevant to be taught to students. At this level also, college students have been able to determine the limits on the material being taught in reference to the core concepts.

### 3.2.3 *Pedagogical Aspects*

Pedagogic aspects or can be called the learning aspects can be analyzed by looking at the summary of the CoRe questionnaire in table 1 namely in numbers 5, 6, 7, 8, and 9. The most prominent thing that is most visible is the ability of college students to predict the problems that will be faced in conveying or teaching certain concepts to students. All college students are still experiencing difficulties and do not yet know what and how difficulties are encountered in conveying concepts to students. This is evident from the results of the Core Questionnaire in Question number 5 about the possible problems that will be faced in teaching certain material.

Another thing that can be seen from the ability of PCK students in pedagogical aspects is the ability to form strategies in learning (question number 6). Students still form strategies in general and are inflexible. Although the strategy has been prepared by adjusting the characteristics of the material, but it is still general. To choose a good strategy college students should be able to change the strategy by adjusting the situation and conditions based on consideration of the characteristics of the concept in each dimension of knowledge and competencies to be achieved. The selection of this strategy can be developed with a direct practice process or with direct experience in the field [12].

The consideration of college students in determining the strategy is still in general, which is still based on the initial abilities of students. Student conditions and class situations have not been taken into consideration in determining the strategy. This can be seen from the results of the PCK questionnaire in number 7, with questions that lead to consideration in the selection of strategies in the learning process. It seems that students have not considered aspects beyond cognitive abilities in students. Padahal aspects other than cognitive are very influential in the process of student understanding of a material [13].

The last two questions from CoRe aim to find out how far college students can organize the material to be taught. Are the college students able to organize material by not focusing on books but more flexible based on the results of the analysis, teaching strategies, and student needs? From the results obtained, The preparation of concepts to be taught by students is still fixated with books. College students have not arranged the order of concepts according to the order of good understanding without nailing to books. It seems that 11 college students are still confused, and arrange the concept sequence according to the book. The ability of students to organize material that is only fixated on books influences the assessment process carried out by students as prospective mathematics teachers. This influence can be seen from the results of the CoRe questionnaire on the last question about assessment. Learning evaluation or evaluation still uses general assessment instruments such as Tests. College students have not yet developed an assessment or evaluation using other instruments that are more creative and relevant for the assessment of student learning outcomes. The test used is a test whose problems have been listed in the book used.

Based on the results of the CoRe questionnaire and analysis of the results of the questionnaire, the PCK level of prospective Mathematics teacher students at PGRI Yogyakarta University viewed from the pedagogical aspect was at the Pre PCK level. This means that the ability of students in developing strategies is still general and fixed on books. Likewise, with the preparation of the material, it still depends on the textbook used. planned understanding of measurement Students only uses tests, not yet developing other assessments.



Of the three aspects observed, two aspects namely the aspect of objectives and aspects of pedagogy on the ability of PCK prospective mathematics teacher candidates at the PGRI Yogyakarta University are still at the Pre PCK level. While aspects of the concept or content of student PCK capabilities are already at the Growing PCK level. So that conclusions can be drawn from these three aspects that the ability of PCK prospective mathematics teacher candidates for Yogyakarta PGRI University is at the Pre PCK level.

#### 4. Conclusion

The results of research and analysis that have been done, students as prospective teachers basically have basic professional competence. This can be seen from the results of data analysis that students are able to organize learning based on the aspects of objectives, content, and pedagogy. However, the level of professional ability or competency possessed by students is still at the basic level or Pre PCK. Seen from 3 aspects of PCK, 2 aspects are at the Pre PCK level and 1 aspect is the content is at the Growing PCK level. This looks reasonable considering students still do not have enough experience in learning and are still focused on discussing mathematics material or content.

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