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Cite as: AIP Conference Proceedings **1911**, 020022 (2017); <https://doi.org/10.1063/1.5016015>  
Published Online: 05 December 2017

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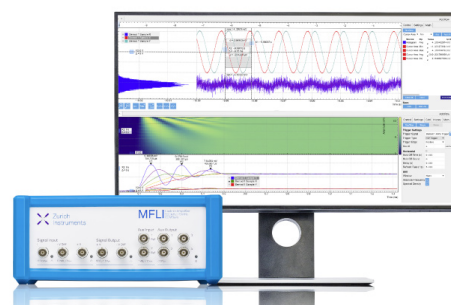
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# Description of Pedagogical Content Knowledge (PCK) and Content Knowledge on Muhammadiyah Semarang University's Preservice Teacher

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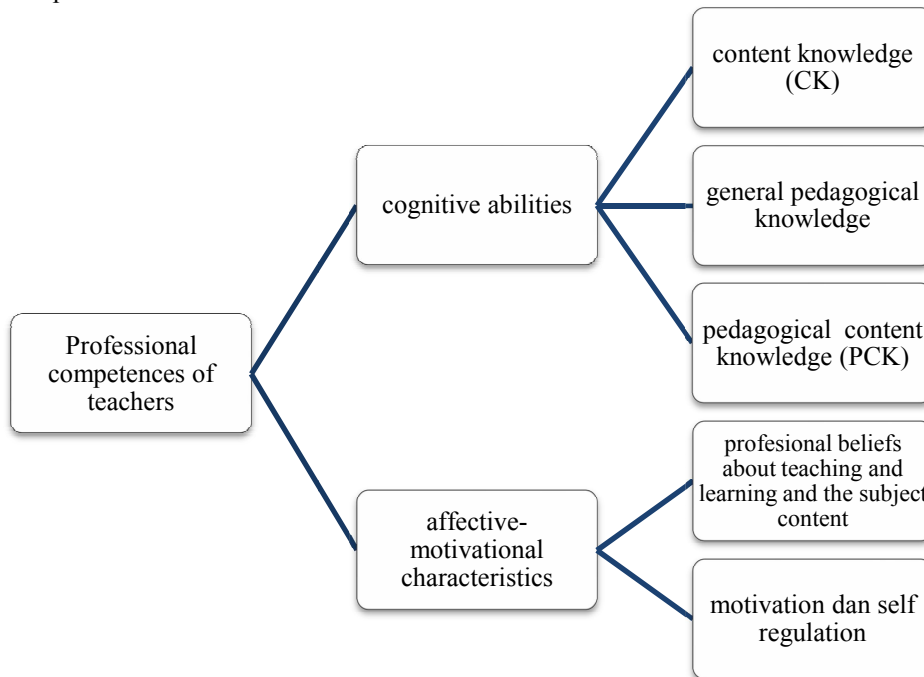
**Abstract.** One of the competencies of teachers to be mastered under the constitution is pedagogic competence. This study aims to provide an overview of the pedagogic competence of Preservice teachers through the mastery of Pedagogical Content Knowledge (PCK) and Content knowledge (CK). The research method used is descriptive qualitative, with data retrieval technique through essay tests, questionnaire and interview. The results showed that of the five PCK indicators, only knowledge of learning strategies to teach chemistry already in high category. For Content Knowledge of preservice teachers are in the middle category for indicators of knowledge of disciplinary content, whereas knowledge that alternative frameworks for thinking about the content exist and the knowledge of the relationship between big ideas and the supporting ideas in a content area is in the fair category.

## INTRODUCTION

In recent years, educational research was identified that teacher's competences had the influenced on students's progress learning. Based on a number of education research studies identified in large-scale literature review, teachers' competences makes a difference in their professional practice and their students' achievement. The improvement in the quality of teaching and learning in classrooms, schools and system related with the capacity of teachers. Some recent research on education states that to improve students' learning achievement, the main thing that needs to be done is to improve teachers' ability. Teacher according to the constitution of the Republic of Indonesia No. 14 of 2005 has the main duty to educate, teach, guide, direct, train, assess, and evaluate students at all levels of education. Professional teachers are required to be competent as a learning agent. In the constitution of the Republic of Indonesia No. 14 of 2005 No. 14 of 2005 on Teachers and Lecturers mentioned that competence is a set of knowledge, skills and behaviors that must be owned, lived, mastered by teachers or lecturers in performing professional duties. This competency consists of pedagogic competence, professional competence, social competence, and personality competence.

Based on the constitution of the Republic of Indonesia No. 14 of 2005 on teachers and lecturers, pedagogic competence is the ability of a teacher in managing the learning process associated with students, including understanding insight or educational base, understanding of students, curriculum development or syllabus. Guerriero's pedagogic competitiveness (2013) is one of the key indicators of qualified teachers. According to Kleickmann et. al PCK and CK is a major component that affects the progress of student learning [1]. PCK and CK

is a component of teacher professionalism [2]. PCK and CK are part of the Cognitive Ability that professional teachers must possess.



**FIGURE 1.** Professional competences of teachers adapted from Blomeke and Delaney [1]

## MATERIAL AND METHOD

This research is a mixed method which uses descriptive qualitative method. The subjects of this study are the tenth and eleventh graders of science program from Senior High School of Semarang which consists of 72 students. Mixed methods are methods that combine qualitative and quantitative approaches especially on the data collection phase or methodology. In addition, this research also uses mixed model studies incorporate two approaches in all stages of the research process [3]. Moreover, Nazir states that descriptive research is a method which conducts the research about a group of people status, an object, a set of conditions, a system of thought or a class of events in the present [4].

This research also used questionnaires in collecting the data which was done by distributing questionnaires to the twelve students of class X and XI Science Class of Senior High School in Semarang, Central Java which consists of 72 students. Questionnaires were distributed to students in order to know the students' opinions about pre-service teachers' PCK. The questionnaire used 40 items of statements consisting of five indicators of pre-service teachers' PCK. Students were asked to fill in a way to tick mark on the column. The test was done to find out CK of the pre-service teachers. This research used 10 items of essay which includes three indicators of CK. Other data retrieval techniques were conducted through interviews. This technique was done to find out PCK and CK of pre-service teachers. This technique was conducted on six respondents of chemistry pre-service teachers who taught at five different schools. This interview technique concerned on the five PCK indicators and three CK indicators.

## RESULT AND DISCUSSION

### Pedagogical Content Knowledge (PCK)

Pedagogical competence measured in this study relates to Pedagogical Content Knowledge (PCK) and Content Knowledge (CK). In addition, the measurements of PCK used five indicators of the pentagon model proposed by

Park and Oliver [5]. The PCK indicators included five components of PCK such as; K1 (the orientation in chemistry teaching), K2 (knowledge of students' understanding in chemistry), K3 (knowledge of chemical curriculum), K4 (knowledge of strategy and representation of learning to teach chemistry), K5 (knowledge of assessment).

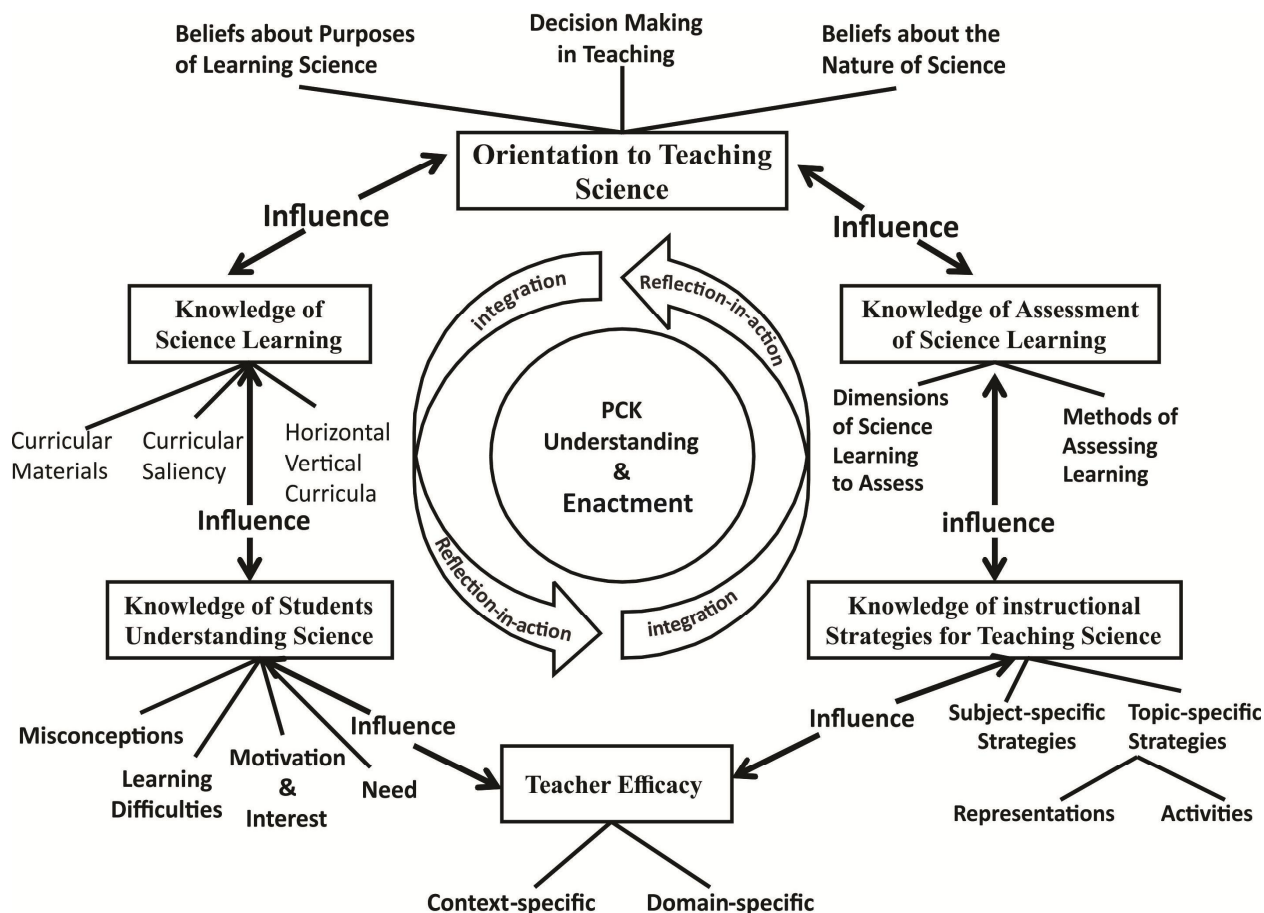


FIGURE 2. Hexagon Model of Pedagogical Content Knowledge for Science [5].

The five components of pre-service teacher's PCK were measured using questionnaires and interviews on six respondents. Therefore, the results of the questionnaires which filled out by the students can be seen from the Table 1 below.

TABLE 1. The result of PCK's pre-service teacher

No.	Indicator	Score	Category
1.	K1 (the orientation in chemistry teaching)	1.87	Fair
2.	K2(knowledge of students' understanding of chemistry)	1.92	Fair
3.	K3 (knowledge of chemical curriculum)	2.87	High
4.	K4 (knowledge of strategy and representation of learning to teach chemistry)	2	Fair
5.	K5 (knowledge of assessment)	1.99	Fair

Based on the table above, the results obtained from the five indicators of chemistry pre-service teacher, the highest score is knowledge of strategy and representation of learning to teach chemistry indicator 2.87 which is included in good category, while the indicator that has the lowest score is the orientation in chemistry teaching 1.87 which is included in enough fair.

Moreover, the results of the research conducted through interviews of six chemistry pre-service teachers in six high schools of Semarang, are summarized in the table below:

**TABLE 2.** Respondent identity

Indicator	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6
Knowledge background	Chemistry Education	Chemistry Education	Chemistry Education	Chemistry Education	Chemistry Education	Chemistry Education
Teaching experience	30 days	30 days	30 days	30 days	30 days	30 days
Class	X, XI and XII	X and XI	X and XI	X and XI	X and XI	X

Based on the interviews result which discussed the most difficult materials in class XI that have been done to chemistry pre-service teachers during their job training in high school. They have been explained that the most difficult material related to chemistry in eleventh class of semester one is thermochemical material. Whereas, there are some of them mention that XI students have difficult learning in thermochemical material, but some argue that thermo chemical material don't make students confused in learning, but students have difficulty learning in reaction rates materials. While the chemistry subject in class X, students have difficulties on the atomic structure material and the periodic system of elements. In addition, students of XII class have difficulties in learning electrochemical material.

### Content Knowledge (CK)

The Content Knowledge indicators which used in this research using of Smith's Research about indicator of CK [6]. There are consists of knowledge of disciplinary content, knowledge that alternate framework for thinking about the content exists and knowledge of the relationship between big ideas and supporting ideas in a content area. The three components of CK's pre-service teacher were measured using test methods and interviews on the six respondents. Based on the results of an essay test which filled by chemistry pre-service teachers, the CK indicator can be seen in Table 3.

**TABLE 3.** The indicator of CK

No.	Indicator	Score	Category
1.	Knowledge of disciplinary content	63.64	Fair
2.	Knowledge that alternative frameworks for thinking about the content exist	44.41	Low
3.	Knowledge of the relationship between big ideas and supporting ideas in a content area	44.14	Low

From the table above, it can be explained that students find difficulties to understand the material especially the exercises of it. The difficulties in mastering chemistry data have been obtained from the questionnaires which distribute to the students. The materials that the students find difficulties to understand in the odd semester are the materials of atomic structure, SPU, hydrocarbon, reaction rate, thermochemistry, chemical equilibrium, colligative properties, electrochemistry, redox and stoichiometry. In addition, Student learning difficulties are the effect of mastery pre-service teacher Content Knowledge. To know the material understanding mastery of the chemistry pre-service teachers especially on the difficult material 61 which can be described that it is included in fair category. The average CK of potential chemistry teachers for difficult materials is 61 in the medium category. The description of pre-service teachers' material understanding mastery on the difficult material is listed in Table 4.

## Discussion

Mastery of PCK is the most important part in determining the success of student learning. But this mastery of PCK can be further enhanced by the longer teaching experience of teachers. Unlike PCK, the mastery of material (CK) is absolutely necessary to be mastered by prospective teachers before they complete their studies at the university level. Good CK satisfaction will make it easier for prospective chemistry teachers to start their career in apprentice school. In addition, better CK mastery will increase students' self-esteem confidence. Based on the results of the study is known mastery of PCK and CK these pre-service teachers are in the low to moderate category. The results of this study provide an overview of the condition of pre-service teachers. This description can be used by policy makers primarily to determine passing standards for pre-service teachers and in-service teachers in positions nationally.

**TABLE 4.**The description of pre-service teachers' material understanding mastery on the difficult material

No.	Material	Means Score	Result
1	Atom structure	61	Enough
2	The periodic system of elements	76.33	good
3	Stoichiometry	84.67	Very good
4	Hydrocarbons	63.5	enough
5	Reaction rate	52.3	Bad
6	Thermochemistry	45	Very bad
7	Chemical equilibrium	40.3	very bad
8	Colligative Solutions	87.67	Very good
9	Redox reaction	53.33	Bad
10	Electrochemistry	44.83	Very bad

Based on this research, there are several information for future research and science teacher education. This research ultimately proposes a model for improving pedagogical skills of pre services teachers and in services teachers. The model used was PCK developed by Loughran et. al [7], Park and Oliver [5], and Hashweh [8]. PCK and CK for science teaching have two main components. First, PCK and CK to improve pre-services teacher's pedagogic ability is the result of an uninterrupted interaction of the five components of PCK and the ten components of CK. Second, the dynamic nature of PCK and CK arises from reflection-in and or -on-action. However, in Indonesia, the understanding of the five components is still very lack. The application of these five components of PCK is interrelated and integrated to guide pre-services teachers and in-services teachers during the teaching and learning process. Research in this field is expected to contribute to a better understanding of the complexity of teaching and learning especially in chemistry education for senior high school.

In order for the concept of PCK and CK to be more useful in the world of education in Indonesia, research on PCK and CK in learning especially in chemistry education should be investigated further. Knowledge of pre-services and in-services teachers about misunderstanding of students (CK) plays an important role in shaping PCK. The teacher's knowledge of student misunderstandings can be analyzed on the following factors of student understanding, type of reasoning, misunderstanding, learning styles, motivation, and so on. Student misconceptions are more easily recognizable when a pre-services and in-services teacher has a richer understanding of CK. To that end, teacher education needs to be more emphasis on adequate CK preparation in combination with an extensive apprenticeship program in schools.

## CONCLUSION

The result of these research shown there were differences in the structures of teacher education were reasonably well reflected in participants' CK and PCK. These result had the corelative result with Imaduddin's research [9]. From these research we known PCK pre-service teacher included in fair category. In the other side CK pre-service teacher was in low category. Just in knowledge of disciplinary content of preservices teacher indicator included in fair category.

## REFERENCES

1. S. Guerriero, "Teacher's Pedagogical Knowledge and The Teaching Profession" in Background Report and Project Objectives (2013) from [http://www.oecd.org/edu/cei/Background\\_document\\_to\\_Symposium\\_ITEL-FINAL.pdf](http://www.oecd.org/edu/cei/Background_document_to_Symposium_ITEL-FINAL.pdf).
2. T. Kleickmann, D. Richter, M. Kunter, J. Elsner, M. Besser, S. Krauss and J. Baumert. *Journal of Teacher Education*. 64, 1, 90–106 (2013).
3. Abbas, Strategi dan Pilihan Mengajar Berbasis Sekolah (Grasindo, Jakarta, 2010). pp. 12.
4. M. Nazir, Metode Penelitian, (Ghalia Indonesia, Jakarta, 2003). pp.34-35.
5. S. Park and J. S. Oliver, *Research in Science Education*. 38, 3, 261–284 (2008).
6. P. S. Smith, Exploring The Relationship Between Teacher Content Knowledge And Student Learning in Proceeding of the NARST 2009 Annual Meeting. (2009). pp.1-17
7. J. Loughran, A. Berry and P. Mulhall, Understanding and Developing Science Teachers' Pedagogical Content Knowledge. (Sense Publishers, Rotterdam, The Netherlands, 2006).
8. M. Z. Hashweh, *Teachers and Teaching: Theory and Practice*. 11, 3, 273-292 (2005).
9. M. Imaduddin, F. F. Hidayah and A. P. Astuti, Deskripsi Pedagogical Content Knowledge Guru Kimia Menggunakan Komponen Model Pentagon. (Chemistry Education of UNIMUS in collaboration with UNIMUS Press, Semarang, 2014).pp 26-35.