The ability of pedagogic content knowledge (PCK) of mathematics teacher candidate based on multiple intelligent

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Abstract. This research is a qualitative descriptive study that analyses the Pedagogic Content Knowledge of prospective mathematics teachers in the practice of learning in secondary school Cirebon. Nine students are taken as participants of the study based on high, medium and low academic ability levels. The instruments were questionnaires and observation sheets in the form of PCK measurement instruments that had been designed for prospective mathematics teachers and were declared valid. The results of the study show that prospective mathematics teachers with high academic abilities have good abilities in compiling learning devices and PCK. For prospective teachers with moderate academic abilities are still relatively good in preparing learning tools, but the ability of PCK is still quite sufficient. Whereas prospective teachers with low academic ability are still quite sufficient in compiling learning tools and PCK abilities.

1. Introduction
Teacher is one of the crucial factor’s successes in learning process, whereas the teacher must have a deep knowledge and understanding of the material that will be taught. Teachers must have in-depth knowledge of how to teach the material which is called pedagogic knowledge, besides that, a teacher also must have a deep understanding of the material that will be taught, this ability is called content knowledge. Many assumptions that if a teacher has a good deep understanding of the material also good in teaching, but this will not be achieved if a teacher lacks of pedagogical knowledge, the integration of understanding and knowledge of the appropriate and good way of teaching is commonly called by Shulman [1] as pedagogical content knowledge (pedagogical content knowledge).

A teacher who has good knowledge and appropriate way of teaching will help students to easily build their understanding of the material which is presented, this ability becomes a requirement for a teacher, especially for math teachers who are required to explain the understanding of an abstract material to be able to absorb easily by students. A mathematics teacher should have a combination of mathematical ability and a pedagogical ability called Mathematics Pedagogic Content Knowledge (MPCK) [2].

Becoming professional math teachers must master seven aspects: mathematics material knowledge, general pedagogical knowledge, pedagogical content knowledge, curriculum knowledge, learning and characteristics knowledge, teaching strategy knowledge, and learning context knowledge.

The development of science and technology impacts on all areas, including education field, it also affects the changing of curriculum where everything demands on teachers' knowledge in teaching,
both material mastery and pedagogic knowledge, whether or not the Teacher can package them into
a series of learning enjoyed by students and will be understood by the students, now the applicable
curriculum in Indonesia is 2013 curriculum which required the teachers to skill fully package the
learning with either one of them is using a scientific approach, must be skilled in using science and
technology, skilled in evaluating both cognitive, affective, and psychomotor, and many other
requirements related to the applicable curriculum.

The process of organizing the teaching learning process nowadays is a teacher is expected to have
four aspects as suggested by UNESCO towards education that are *learning to know*, *learning to do*,
*learning to be*, and *learning together*. These have an impact on all related institutions including
LPTKs that construct candidate of teachers, Unswagati is one example of private Teaching Institution
in Cirebon which has several study programs that continually strive to prepare professional teacher
candidates, steps and strategies are continuously strived for the realization of producing graduates
who have capability and competitive.

One of Unswagati's study programs is mathematics education, to produce professional
mathematics teacher candidates, many ways that have been done curriculum improvement, teaching
aspect, and research aspects. In the improvement of curriculum aspect, there is development of
subject such as in the previous curriculum there is only the Teaching Practice Program (PPL) subject
with 3 months implementation, now it is developed into a new course there is apprenticeship program
for 2 months implementation before Teaching Practice Program (PPL), in this program students do
observation/learning directly in schools related to pedagogical administration and knowledge (PCK)
such as syllabus, lesson plans, evaluation questions, teaching-learning activities, extracurricular
activities and other school activities. After passing the apprenticeship program, students continuing
to Teaching Practice Program (PPL) with 3 months duration, the expectation during the
apprenticeship program is that students can get real pedagogic knowledge in the school before
practicing, whereas previously they only obtained pedagogical knowledge theory and math materials
from lectures, as well as micro practices, such as the results of research conducted [3] that only 70%
of students are able to ask questions clearly. Whereas in Teaching Practice Program (PPL) activities,
students are required to practice in the classroom from the knowledge of the apprenticeship program
and the lectures they have obtained. The way of LPTK to improve other aspects is through research,
in this aspect has been done related to the design of measurement instruments *Pedagogic Content
Knowledge* (PCK), from that research, a valid and practical *Pedagogic Content Knowledge* (PCK)
measurement tool for mathematics teachers candidate is produced, but the research that has been done
is not known to what extent the ability of *pedagogic Content Knowledge* (PCK) from a subject that
is taken, from a background that has exposed, it needs to conduct more research related to how the
ability of *Pedagogical Content Knowledge* (PCK) of mathematics teachers candidate who follow
Teaching Practice Program (PPL) at SMP/SMA Negeri Kota Cirebon. The research is formulated
more in depth into the question, how is the ability *Pedagogical Content Knowledge* (PCK) of
mathematics teachers candidate based on high, medium, and low academic ability in SMP/SMA of
Cirebon city?.

Limitations of the problem in this study is to measure the ability of *Pedagogical Content
Knowledge* (PCK) of mathematics teachers candidate before and after the Teaching Practice Program
(PPL), using instruments *Pedagogical Content Knowledge* (PCK) that meets the seven criteria,
namely: (1) material knowledge, (2) general pedagogical knowledge, (3) pedagogical content
knowledge, (4) curriculum knowledge, (5) learning and characteristics knowledge, (6) teaching
strategy knowledge, and (7) learning context knowledge [4].

2. Methods
This study used descriptive qualitative method. The subject of this research is 9 students of 3rd grade
of Mathematics Education Study Program which is grouped based on high, medium, and low academic ability.
3. Results and Discussion

This section will describe the discussion of the ability of PCK of mathematics teachers candidate based on high, medium and low academic ability, based on the seven criteria of PCK with indicators:

1. Check the readiness of the room, learning tools, media, and checked the students’ readiness
2. Use various techniques to motivate students’ willingness to learn
3. Ability to link the material with other relevant knowledge, science and technology development in daily life
4. Level of explanation accuracy with learning materials
5. Ability to present the material contextually, easily to difficult, and concrete to the abstract.
6. Implement the learning activities in accordance with the design that has been compiled completely include: introduction, whilst, and conclusion.
7. Implement learning activities which aim to help the students’ learning process
8. Response to the students’ error as the stages of the learning process
9. Ability to use teaching aids (IT, property) to motivate students
10. Provide opportunities for students to ask
11. Have good classroom management
12. Implementing the contextual learning
13. Implementing the learning in accordance with time allocation that is planned
14. Facilitate the interaction of teachers and students
15. Monitor the learning progress
16. Carry out follow-up and provide reinforcement.

Based on research conducted [4] that there is an influence between teaching experience and the development of a teaching process design for a prospective mathematics teacher in a field experience program. This is evidenced by the results of the monitoring of teaching practices in the classroom. The process of teaching practice activities has been given guidance and input related to what must be prepared in class.

The process of teaching activities in this study is a student learning centre where students play an active and independent role. Students become an important part that influences the content of the material, activities, and the material itself. Through this learning method, students take the main role in the learning process, and the teacher switches functions into a learning partner or facilitator.

The Student Learning Centre refers to the PCK criteria, which is to carry out learning activities that aim to assist the learning process of students, facilitate the interaction of teachers and students, monitor the progress of learning, reflect or make summaries by involving students, and carry out follow-up and reinforce material.

In this Student Learning Centre activity, the subject of the study presents the material contextually, from easy to difficult, and from concrete to abstract, this is reflected in the learning plan that is made and practiced in the classroom. The following data shows the average of PCK ability based on high, moderate, and low academic ability from 17 indicators that is studied.

![Figure 1. Average of PCK Ability](image)

Figure 1. above shows that the average of PCK ability for high and medium group is categorized as very good with successive value 3.78 and 3.52. While the average of PCK ability of low-group is categorized with good value which is 3.02.

The teaching experience of research subjects greatly influences PCK's ability to practice teaching in the classroom. Subjects with high ability do not guarantee that they have good teaching practice skills.
Based on observational data, for some specific cases, a prospective student who has high competence and gets a bad teaching process, this is due to lack of experience and lack of self-confidence. It turns out that this is in line with the results of research conducted [5] who reported that the Self Confidence of Mathematics Teachers in Practice Field Experience is still very lacking due to lack of experience. From the results of interviews, there were several subjects in this study who were of moderate or even low ability but they had good skills in teaching practice, this was because they had good confidence and teaching experience, proven, many of them had become private tutors. The subject's intellectual abilities will affect them in making learning devices. Subjects with high ability have good abilities in making learning devices compared to moderate and low ability, although in teaching practice it is not necessarily good.

Besides PCK ability, this research also studied that is related to the ability in constructing learning device based on indicator: (1) the ability to arrange syllabus, (2) design the lesson plan in accordance with syllabus, (3) follow the learning sequence and pay attention to learning purpose (4) choose learning material that relevant to situation (5) select the source or learning media (6) the accuracy of learning scenarios (7) designing the assessment with various techniques and types (8) the appropriateness of techniques and types of assessments in accordance with learning objectives (9) the completeness of assessment instruments that will be presented through the following diagram.

The following diagram below presents the data of ability to compile the learning device of mathematics teacher candidate based on high, medium and low academic group.

![Figure 2. Average Data of the Ability to Compile Learning Devices](image)

**Figure 2. Average Data of the Ability to Compile Learning Devices**

Based on Figure 2. above, it is seen that the average of ability of compiling learning device for high and medium ability group are in very good category with successive value 3.74 and 3.56. While the average of ability for low ability group is in good category with value 3.15.

### 3.1. The ability of PCK Mathematics Teacher Candidate with High Academic Ability

This academic group is analysed one by one on each indicator based on 7 indicators of PCK. These are the data of PCK in each indicator.

| SUBJECT | INDICATOR | Average |
|---------|-----------|---------|
| Ss 1    | 3 4 3 4 4 4 3 4 3 4 3 4 4 4 4 3.65 |
| Ss 2    | 3 4 3 4 4 4 3 4 3 4 3 4 4 4 4 3.82 |
| Ss 3    | 3 4 3 4 4 4 3 4 3 4 3 4 4 4 4 3.88 |
| Average | 3.67 3.33 4 4 4 3.67 4 3 3.33 4 4 4 4 |
Based on the data in Table 1, it can be seen that the average ability of PCK high group is categorized as very good category. The ability in indicators 3, 7, 11, 12 categorized as good category, it means that students are able to manage the class well and do the contextual learning therefore it can help students to learn. Moreover, other indicators for this group is already in very good category, means the ability of pedagogic content, the ability of mastery of the material and general knowledge of mathematics teacher candidate in teaching practice has been very good.

3.2. The ability of PCK of Mathematics Teacher Candidate with Medium Academic Ability
This academic group is analysed one by one on each indicator based on 7 indicators of PCK. These are the data of PCK in each indicator.

| SUBJECT | INDICATOR | Average |
|---------|-----------|---------|
| Ss 1    | 3 3 2 4 4 4 4 3 4 4 4 4 4 4 4 | 3.647   |
| Ss 2    | 3 2 2 4 4 4 4 3 2 4 3 3 4 4 3 4 4 | 3.353   |
| Ss 3    | 4 3 3 4 4 4 4 3 3 4 3 3 4 4 4 4 4 | 3.706   |
| Average | 3.33 2.67 2.33 4 4 4 3.33 3 4 3.33 4 4 3.67 4 4 |         |

Based on the data in Table 2, it can be seen that the average ability of PCK of medium group is being included in the very good category. For the ability in indicators 2, 3 included in enough category means the students are still limited to use various techniques to motivate the students' willingness to learn and still not able to link the material with other relevant knowledge, the development of science and technology and real life. For the ability in indicators 1, 8, 9, 11, 12 included in good category means students are already well on the readiness of the learning device, check students' readiness and response to students' error, manage class room and perform contextual learning. Whereas for other indicators for this group is quite good, means that the ability of pedagogic content, the ability of mastery the material and general knowledge of mathematics teacher candidate in teaching practice has been very good.

3.3. The ability of PCK of Mathematics Teacher Candidate with Medium Academic Ability
This academic group is analyzed one by one on each indicator based on 7 indicators of PCK. These are the data of PCK in each indicator.

| SUBJECT | INDICATOR | Average |
|---------|-----------|---------|
| Ss 1    | 3 2 3 3 3 3 4 2 3 3 3 3 2 3 3 3 3 | 2.882   |
| Ss 2    | 3 2 2 3 3 4 3 3 2 4 3 2 4 4 3 3 4 | 3.059   |
| Ss 3    | 3 2 2 3 3 4 2 3 4 4 3 2 4 4 3 3 4 | 3.118   |
| Average | 3 2 2.33 3 3 4 2.33 3 3 3.67 3 2 3.67 3.67 3 3 3.67 |         |

Based on the data in Table 1.3 it can be seen that the average ability of PCK of low group is included in good category. For the ability in indicators 2, 7, 12 included in enough category means students are still limited to use various techniques to motivate the students' willingness and still not able to link the material with other relevant knowledge, the development of science and technology and real life and carry out learning activities that can help learners learn. For the ability in indicators 1, 4, 5, 8, 9, 11, 15, 16 included in good category means that students are good in the readiness of learning devices, checking the students’ readiness and responding the students’ errors,
managing classroom and doing contextual learning. While for indicator 6 for this group have been classified as very good category, means that students have done the learning activity in accordance with design which has been compiled.

4. Conclusion
Mathematics teacher candidate with high and medium academic ability and is having a very good ability in developing learning devices and the ability of PCK. Moreover, mathematics teacher candidate with low academic ability are still quite good in developing learning devices and the ability of PCK. Generally, the ability of PCK of Mathematics teacher candidate is quite good, but there are some things that need to be developed, such as giving knowledge to Mathematics teacher candidate related learning techniques that can develop students’ motivation, the ability to implement contextual learning, the ability to link the material with relevant knowledge, according to the development of Science and Technology.

To develop the ability of PCK of Mathematics teacher candidate can be made teaching materials (books / diktat / module) that can improve the ability of PCK. In the teaching practice, students’ ability in utilizing IT-based media is still not optimized therefore it is necessary to apply the habit of using IT-based media in teaching practice. For those who have lack of confidence due to lack of teaching experience, it is recommended that they take the teaching matriculation before joining the school field practice program.

5. References
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