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Enhancing the prospective biology teachers' Pedagogical Content Knowledge (PCK) through a peer coaching based model

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Abstract. This paper presents the results of implementation Peer Coaching Based Model that was implemented in development and Packaging Learning Tool program aimed at developing a Pedagogical Content Knowledge prospective teachers' capabilities. Development and Packaging Learning Tool is a training program that applies various knowledge, attitude, and skill of students in order to form professional teacher. A need assessment was conducted to identify prospective teachers' professional needs, especially PCK ability. Tests, questionnaires, interviews, field notes and video recordings were used in this research. The result indicated that the ability of Prospective teachers' PCK has increased. This can be shown from the N-Gain that included in the medium category. This increase shows that there is integration of pedagogy and content; they have used varied strategies and can explain the reasons for its used. This means that the pattern belongs to the lower limit of the growing- PCK category. It is recommended to use peer coaching model during peer teaching.

1. Introduction

Education is increasingly important to the success of both individual and nations. This has an impact on the demands on teachers to be able to keep order and provide useful information to students, enabling a diverse group of students to learn ever more complex material and to develop a wider range of skills are increasing. Teachers' abilities are especially crucial contribution to students learning. Teachers need to know how to take the steps necessary to gather information that will allow them to make more grounded judgement about what is going on and what strategies may be helpful. The teachers should understand and be able to integrate knowledge of the content into lessons on curriculum, teaching, learning, and students. Such knowledge can guide teachers to assemble learning situations based on the needs of individual and group of students. That knowledge known as Pedagogical Content Knowledge.

The person who is called the teacher is the person who has the ability to design a learning program and it is able to organize and manage the class so that learners can learn and ultimately can reach the level of maturity as the ultimate goal of the educational process. The teacher is a profession, which means a position that can require special skills as a teacher and cannot be done by any person who do not come from the field of education. For that preparation of a professional teacher must be prepared from the beginning that is when they are still a prospective teacher. A prospective teacher should be



able to plan and incorporate appropriate science teaching strategies for learners with diverse backgrounds and learning styles^{1,2}.

Professional competence of biology teacher in high school is required to master the materials, structure, concepts and mindset of scholarship that support the subjects that he or she is receiving in school³. Quoting from Lawrence D. Hazkew and Jonathan: Teacher is a professional person who conducts classes ". Meanwhile, according to Jean D. Grambs and C. Morris Mc Claire in the Foundation of Teaching An Introduction to Modern Education," The teacher is someone who has the ability to organize and manage the class". To meet expectations that they face now, Programs that prepare teachers need to consider the demands of school nowadays in concert with the growing knowledge base about learning and teaching if we want to produce the professional teachers.

Prospective teachers as one of the most important elements that will be responsible to teaching biology with good and right, need to be equipped with a mastery of the basic concepts (content) is strong as well as the ability to teach content well and correctly. This means that prospective teachers should have good knowledge and skills about PCK, which hope they will be able to do the learning well too. PCK is a knowledge of experience and expertise gained through classroom experiences. PCK is an important knowledge and must be owned by a teacher^{4,5}. PCK is a form of teachers' professional knowledge that is highly topic, person, and situation specific^{6,7}. Based on the results of several studies show that PCK is important to introduce to prospective students and hoping that they will be able to develop their PCK. The research about PCK has not been deep. No research has developed a teacher's PCK with an explicit approach, in the sense that it is still limited to the search for what is needed, not to the extent of the implications. Because of the importance of PCK that a teacher must have, PCK needs to be explicitly introduced to prospective students, hoping they can continue to develop their PCK skills after becoming a teacher. In other words, provide briefing about the PCK to prospective teachers before they do the real teaching at the school.

In teacher preparing program at Sriwijaya University in Indonesia, there is the Development and Packaging Learning Tool program, it is a training program that applies various knowledge, attitude, and skill of student in order to forming professional teachers. But that program did not make prospective teaches learn how to work, discuss, reflect on, and evaluate in peer communities to improve their Pedagogical Content Knowledge. Therefore, Peer coaching models is a model that prepare prospective teachers to have a command of critical ideas and skills, equally important, the capacity to reflect on, evaluate and learn from their friend and teachers so that it continually improves, hoping their PCK ability will be increase. Based on the reasons above, this study tried to use peer coaching model to develop the pedagogical content knowledge of prospective biology teacher.

2. Method

This paper based on a two-year research project that consisted of two main step. The first step was identifying teachers' professional knowledge especially about PCK. It was conducted by distributing needs assessment to teachers and prospective teachers. The second step was to develop the peer coaching models and do face to face training sessions

This study used Concurrent Triangulation Design⁸. In this design the researcher collected quantitative and qualitative data concurrently, then compares these two databases to determine whether there is convergence, differences, or some combination. This research was conducted at the Biology Education Program at a State University in South Sumatra, Indonesia. The activity of this study involved 20 students who are joined the teaching training program.

The researcher used tests, questionnaires, field notes, video recordings, and interviews to collect the data. To ensure genuine responses from the prospective teachers, interviews were conducted in small groups, though they were individually assessed and did three times test. All interviews recorded and then transcribed and careful noted while interviewing. In data analysing, the researcher used grounded theory, begun with open coding to identify concepts. Then, give labels to each unit of text from transcripts, field notes, test and interviews, forming the basis for identifying concepts throughout the data set, then compare the categories according to Anwar⁹

3. Results

This research was aimed to describe how the ability of student PCK prospective teachers who have done peer teaching and real teaching through peer coaching. In Previously, the assessment instrument and assessment rubrics were developed. Then, measure the ability of prospective biology teacher PCK before and after using peer coaching model and real teaching.

3.1 Perform peer teaching with peer coaching approach

Peer Coaching is an approach applied when implemented peer teaching. In the first stage, a prospective teacher acts as a teacher while the other teacher and lecturer as an observer. In the second stage, after a prospective student teaches he or she will evaluate himself or do self-reflection. Third stage, prospective teacher who acts as an observer and lecturer will provide insert in the form of suggestions and criticism of prospective teachers who have taught earlier. This approach emphasizes the shared learners, while at the same time they learn and evaluate themselves and their peers. Each student displays her teaching planning, while the other student acts as a student as well as an observer who assesses her students' teaching ability. When they assess the ability to teach their friends, in accordance with the planning that has been made, then they also do self-evaluation, do self-reflection of the ability of his friend. It was then that they indirectly developed their PCK capabilities. As Pollard points out, reflective activity often helps the development and maintenance of professional skills¹⁰.



Figure 1. Peer Coaching Approach

3.2. Prospective teachers' content representation skills

The ability of the content representation can be seen from how prospective students describe material content related to learning in class¹¹. How can they be able to determine why students need to learn ideas / concepts? Why is it important for students? What things should be explained and not the time explained? What difficulties are usually faced by students? How students think about the concept? What factor that affect the teaching of the concept? How to teach the procedure? How do students understand or confusion learn the concept? Essential concepts raised by prospective teachers can be seen in the following table:

Table 1. The Important Concepts That Appear Before and After Using Peer Coaching

No.	Concepts	Test		
		I	II	III
1	The history of Virus	√	√	√
2	The Structure of Virus	√	√	√
3	The characteristic of Virus	√	√	√
4	Virus replication	√	√	√
5	The Role of virus	√	√	√
6	Lytic Cycle	√	√	√
7	Lysogenic Cycle	√	√	√

8	The Harmful of Virus	√	-	-
9	The Profitable of Virus	√	-	-

There are differences in the number of concepts raised by prospective teachers who used peer coaching approach (Table 1). After peer teaching fewer essential concepts / ideas are raised by prospective teachers, after peer teaching using peer coaching models students bring more important concepts to be taught. Teachers need flexible understanding of subject matter link to an appreciation for how students learn, to make content accessible to learners. The CoRes of pedagogical content knowledge is knowing how students understand their particular subjects and having a repertoire of strategies to help student engage ideas central to discipline.

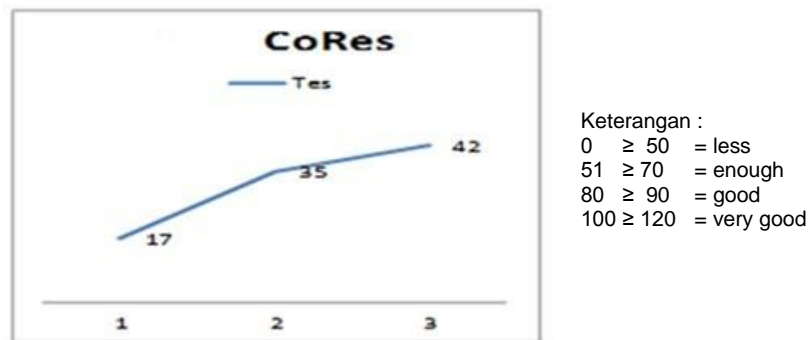


Figure 2. CoRes Value

The value of the representation of the content shows improvement before and after do peer teaching used peer coaching approach and after doing practice teaching in the field. Improvement after peer teaching used coaching approach showed a good improvement. In peer coaching, prospective teachers get feedback on their performance, which shows they have or have not understood what is taught and how to teach it. In addition, they also learn to give feedback to their friends, who in that way also indirectly they self-correct. As expressed by Langs and Evan that giving and receiving feedback will have a profound effect on teacher development in teaching practice¹².

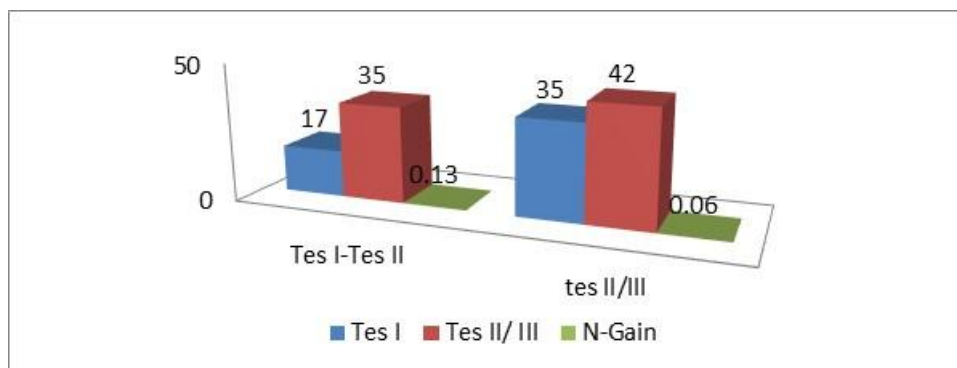


Figure 3. The N-gain of CoRes

From the Scores of N-Gain there is an increase too from the test I to the Test II (after peer coaching) and Tests III after PPL (real teaching). Enhancement after peer coaching was medium category N-Gain: 0,13), while in the third test was classified as low category (N-Gain: 0,06). It shows that peer coaching model is able to improve the ability of prospective teachers PCK.

Table 2. Prospective Teachers' Pedagogical Content Knowledge

No.	Idea/concept	Before peer coaching	After peer coaching
1	Understanding of pedagogy media	There are prospective teachers who have not been able to distinguish between methods and media, such as prospective teachers call the animation as a method.	All prospective teachers are able to distinguish between methods and media
2	Variation of strategy	The methods and media used tend to be less varied. The methods used are more varied	There are use of models and methods not mentioned by prospective teachers
3	Consideration of selection of teaching strategies	Has not considered the efficiency of time and practicality in its use in the classroom.	Less consideration of practicality.
4	The development of mastery of teaching strategies	Initially there are prospective teachers who have not been able to determine a strategy to teach a concept, because knowledge of their pedagogy is still limited.	Have started to have an idea how to teach a concept

The Scores of pedagogy of prospective teachers also increased quite well, which means the ability of teacher pedagogy was getting better. Before peer coaching, the PCK category are still in pre-PCK, after used peer coaching models increase to growing-PCK. This increase has begun shows the integration of pedagogy and content, they have used varied strategies and can explain the reasons for its used. This implies that this pattern belongs to the lower limit of the growing- PCK category¹³.

4. Discussion

After peer coaching, the used of variable methods was increasingly and the used of this method has been associated with material characteristics. Each content has certain characteristics and this will be related to how the content should be presented, for example declarative knowledge presented with a proposition, whereas the procedural knowledge by production. Declarative knowledge can be communicated verbally, procedural knowledge is not. The content of science is simple or complex, concrete or abstract and open or closed for general experience, this difference will certainly differ in the way to learn it and teach it^{14;15}. Peer coaching models prepare prospective teachers need to have a command of critical ideas and skills, equally important, the capacity to reflect on, evaluate and learn from their friend and teachers so that it continually improves, and their PCK ability was increase.

Improvement after peer teaching used coaching approach showed a good improvement. It's reached the upper limit of the pre- PCK category. The term pre PCK describe the early stages of the interaction between pedagogy with content. In *the pre-PCK* prospective teachers have not been able to find a link between knowledge and pedagogical content knowledge so that no slice / integration between the two. At this stage of *Growing PCK*, teacher candidates begin to integrate content and pedagogy that has begun to form a wedge between content and pedagogy. In the maturing stage of PCK, it has been increasingly mature teacher and teachers are able to integrate content and pedagogy in a flexible and rational¹³.

In peer coaching, prospective teachers get feedback on their performance. The purpose of providing feedback is to narrow the gap between existing understanding and learning goals. Reflection is fundamental to assessment, decision making, and a deeper understanding of the teaching practice. The act of reflection is primarily concerned with developing insights and discovering solutions to difficulties, or what might be described more correctly as learning opportunities to revise the next

topic instructional strategies^{16;17}. Feedback can be a reinforcement on students for a successful performance. Improvement also occurs after the student candidates do teaching practice in the field. At the time of the prospective teachers do the real teaching is faced with real state in the classroom, so this experience helps many prospective teachers in developing their abilities. This real teaching helps teachers in improving the planning and learning processes that occur.

The improvement education is depended on teachers PCK, to improve theirs PCK depends on the preparing program. The prospective teachers must work in settings where they can use what they know, work with other friend and teachers to provide a coherent. Hammond and Bransford, similarly reported that the focus is not on the format, length or location of teacher education but on its substance: what prospective teachers need to learn and how they may best be enabled to learn it¹⁸.

5. Conclusions

The ability of prospective teachers' PCK has increased. After peer teaching used peer coaching approach, the improvement of students' PCK ability has improved quite well, including in medium category. In peer coaching prospective teachers get feedback on their performance, which shows they have or have not understood what is taught and how to teach it. In addition, they also learn to give feedback to their friends, who in that way also indirectly they self-correct. As expressed by Langs and Evan that giving and receiving feedback will have a profound effect on teacher development in teaching practice [12]. The purpose of providing feedback is to narrow the gap between existing understanding and learning goals. Feedback can be a reinforcement on students for a successful performance. Peer coaching models is a model to prepare prospective teachers need to have a command of critical ideas and skills, equally important, the capacity to reflect on, evaluate and learn from their friend and teachers so that it continually improves their PCK ability will be increase. Based on it, I argue that the prospective teacher education curriculum should help prospective teacher learn how to work on the improvement of practice as members of such collaborative communities. They can learn how they can engage in partnership in community. From this analysis of the peer coaching approach I recommended the prospective teachers' preparing program better to used peer coaching models to improve the pedagogical content knowledge and skill.

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