DEVELOPMENT OF CHEMSITRY TEACHER PROFESSIONALISM THROUGH PEDAGOGICAL CONTENT KNOWLEDGE TRAINING

Sri Haryani, Sri Wardani, Agung Tri Prasetya

Chemistry Department, Mathematic and Natural Science Faculty,Universitas Negeri Semarang
Email: haryanimail@gmail.com

Abstract. This study aims to analyze the impact of Pedagogical Content Knowledge (PCK) training to the development of chemistry teachers' professionalism through MGMP. The study involved 5 chemistry teachers who measured the PCK capability through filling CoRe (Content Representation) and writing PaP-eRs (Pedagogical and Professional-experience Repertoires), which represents the PCK of a teacher as proposed by Loughran. Quantitative data drawn from the results of the fillingCoRe,Lesson Plan (RPP), and PaP-eRs instruments, whereas qualitative data were taken from the three linkage analysis supported by the results of the interview. Based on the results of data analysis revealed that PCK training can develop the teachers professionalism as measured by the PCK capability especially in minimizing the weaknesses that have been prevalent as how to express apperception, the depth of the material, determine the learning strategies, and pay attention to the prerequisites material.

Keywords: Pedagogical Content Knowledge; teacher professionalism; training.

INTRODUCTION

Formally Teachers and Lecturers has been recognized as professionals with the task of planning and implementing the learning process, assessing the learning results, coaching and training, and conduct research and community service, particularly for educators in universities (Depdiknas, 2003). As professionals, the consequences to be faced is that the teacher must have the standard competencies, i.e. pedagogy, personality, social, and professional competence (Peraturan Pemerintah No. 19/2005). Standard competencies for teachers for each subject is increasingly evident with the release of Permendiknas No. 16 Th. 2007. For professional competence, high school chemistry teacher required competence in a quite complex academic fields. As an illustration, there are 14 things that must be held by chemistry teacher, among which are: (1) understand the concepts, principles, and theories of chemistry and its application in a flexible and (2) creative and innovative in the application and development of chemistry

and related science (Permendiknas No. 16/2007). Both kinds of competence requires deep mastery and understanding of the chemistry content as same as the ability toteach it. Shulman (1987) argued that the two should be integrated in learning to generate new knowledge that is Pedagogical Content Knowledge (PCK). In other words, PCK is the knowledge in organizing content that suited to the task of teaching, which is beneficial to improve the understanding of the learners.

In order to represent the PCK of a science teacher, Loughran, et al. (2006) developed a format that includes the important aspects of a successful science teacher in understanding the subject matter knowledge of science and pedagogy. PCK special format consists of two elements. The first element is called CoRe (Content Representation; 'core') offer a perspective of specific content being taught when teaching a topic. The second element is called PaP-eRs (Pedagogical and Professional-experience Repertoires), which is a short but has specific meaning and is intended to demonstrate the implementation of the CoRe's aspects. PCK capability of a teacher is represented by CoRe and related PaP-eRs, combined to produce PCK Resource Folio on specific content.

Teacher has task of reforming the students' knowledge, and culture in schools. Reformationcannot be done by top-down or outside the will of the teacher. Teachers need to be convinced of the importance of change, and perform vigorously to implement these changes. If teachers do not fully understand their duties or are not sufficiently equipped with adequate preparation to teach new content and how to teach it, then the reformation will be hampered. One improvement of teaching profession is through teacher training activities by Subject Teachers Council (MGMP). Subject TeachersCouncil provide a container that enables chemistry teachers achieve maximum professional development through self-capacity development. Various Chemistry MGMP in Semarang which had collaborated with researcher team of which is assistance in developing problem-based learning tools, including media and assessment (2009-2014). Nevertheless, the PCK capability of a teacher relating to professional competence and the implementation of learning in the classroom has not been done. Through this study the assumption that the implementation phase is the authority of teachers, others do not need to know, even taboo if viewed by the others can be eliminated because of the feedback would be very useful for further improvement.

Taking into consideration the importance of professional competence of teachers devoted to completely combining pedagogy ability and comprehension of material content, the PCK training through MGMP is a real need, is very important and potential to do. Therefore, specific

training aimed to combine pedagogy ability and comprehension of material content or training themed Pedagogical Content Knowledge (PCK) needs to be done. Implementation of training programs that equip this PCK concept provide wider opportunities for teachers to play an active role in developing the competence in designingLesson Plan (RPP) (Louhgran, et al., 2006; Purwaningsih, 2011; and Hamida, 2011). PCK capabilities focused on the competence of teacher candidates in preparing CoRe documents, lesson plan, and PaP-eRs. The question that arises is: Do the training will changes the teachers'PCK capabilities?

METHODS

This descriptive study was conducted through MGMP Semarang, with research subjects 5 chemistry teacher. The basic consideration choosing the research subject because teachers who are members of the Chemistry MGMP that previously been established a cooperation began in 2008, either through community service activities and collaborative research. Research design using triangulation to simultaneously collect qualitative and quantitative data, comparing results, and then use the results to see linkages (Creswell, 2009). Research procedure begins with briefing material PCK conducted through lectures and question and answer session, followed by the writing of the CoRe document for each teacher (Table 1) and writing lesson plans and worksheets with material based on CoRe, classroom practice, and ends the writing PaP-eRs that written after carrying out classroom practice. Interviews were conducted to explore the relationship between writing CoRe, lesson plan, the implementation of classroom practice and PaP-eRs were written. In addition, interviews were also intended to find the factors that influence and constraints of teachers' PCK development.

Data is collected using instruments of the CoRe question sheet as a form of teachers' PCK capability (Loughran et al., 2012), lesson plans evaluation sheets, PaP-eRs assessment sheets, and unstructured interviews as field notes. Teacher professionalism in this study were identified from the ability to represent the content to be taught (CoRe) as a form of PCK capability of teachers (Loughran et al., 2012) and is associated with the lesson plan. CoRe results were scored using the CoRe rubric, as well as for the lesson plan and PaP-eRs were analyzed by lesson plan and PaP-eRs rubric, CoRe,lesson plan and PaP-eRsassessment results (Figure 1), used to see the trend of the three. Qualitative analysis is done by analyzing the links between CoRe, lesson plan and PaP-eRs, all data collected in the form of portfolio: lesson plan, the process of assistance with the research team, CoRe, PaP-eRs, and interviews. This portfolio is collected to describe the overall study results.

Table 1. CoRe Aspects Guidance

This Core is designed for student in Middle Secondary School	important science ideas/concepts				
	A	B	C	D	dst
What you intend the students to learn about this idea?					
Why it is important for student to know this?					
Why it is important for student to know this?					
This Core is designed for student in Middle Secondary School, i.e., year 10.					
What else you know about this idea(that you do not intend students to know yet)					
Difficulties/limitations connected with teaching this idea.					
Knowledge about students' thinking which influences your teaching of this idea.					
This Core is designed for student in Middle Secondary School, i.e., year 10.					
Other factors that influence your teaching of this idea.					

RESULTS AND DISCUSSION

Instruments to measure the PCK capability refers to Loughran et al. (2004) have reported the research is a 2-year longitudinal study using CoRe and PaP-eRs data to document and display PCK of science teachers. Research conducted by Loughran produce CoRe documents and PaP-eRs for different range of subjects (ie. chemical reaction, ecosystems, force, genetic, circulation systems). Another interesting thing that was found was each topic contains a need to better understand the complexity of the content and pedagogy, which creates different expectations, which also applies to the teachers concerned. Table 1 shows the CoRe components that must be written by teacher before designing the lesson plan. The three documents writing on this research is still in the testing phase, each teacher was starting to write one material so that from the three documents that have been analyzed is only one.

Once teachers acquire PCK debriefing materials including example to fill CoRe data from Loughran, then teacher trained to design CoRe according to the previously agreed materials. At first the teachers seem not many ask the question, but after writing independently they statedtohavedifficulties, just not try seeking information or assistance. The PCK capability of a teacher analyzed from the CoRewas descriptive associated with compiled lesson plan. Interviews are used to support linkages to the three documents, and are reflective to the PCK capability. Based on Figure 1 can be seen that the teacher's PCK capability measured through core and papers in line with the ability of lesson plan preparation. The findings of this study are consistent with findings of Goolamhossen (2013) which found that the higher the teacher student conceptual understanding, the higher the pedagogical abilities owned (Ozden, 2012). Nonetheless, Ozden stated that there are teachers who have goodpedagogical abilities because of the other factors, which is communication skills.

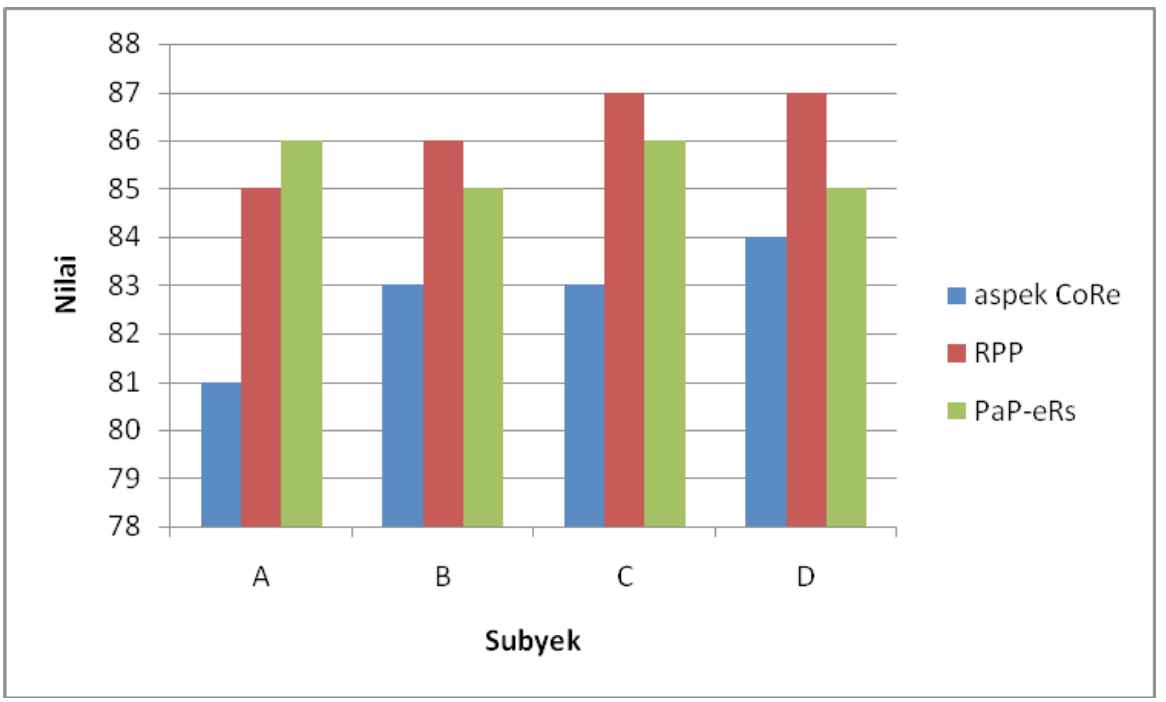

Figure 1. Results of the CoRe, lesson plans, and PaP-eRs assessment

Along with the CoRe document and PaP-eRs preparation activities, also held discussions with each of the research subjects. The issues discussed between researchers and teachers, among others: (1) preparing apperception so that learning becomes meaningful, (2) a prerequisite material, (3) the depth of the material, (4) misconceptions that may arise, (5) preparation of lesson plan based on learning models, and authentic assessment. Here is the example of description linkages of CoRe document preparation and PaP-eRs with the preparation of lesson plans written by the research subject equipped with CoRe assessment rubric.

CoRe Document Questions, number 1: What do you want students to learn from this idea?

Determination of the content that will be given to students by teachers an important concept as a great idea represented with how teachers identify indicators of learning in different ways. A large number of ideas which are written by the teachers varied from 3 to 5. Someteacher candidates using sub subject of the order required competencies. As an example for the material solubility and solubility product consists of three important concepts, in contrast to the buffer solution consists of 6 important concepts. Relating to the material order, to buffer and hydrolysis there are two important concepts that can be combined into one concept. For example, for mixture of buffer solution teacher sorts important concepts as follow: the concept of a buffer solution, a mixture of buffer solution, acid-base reactions, type of buffer solution, pH determination and usefulness of buffer solution. The important concept that does not exist is the mechanism or how

the buffer solution work, while the mixture of buffer solution and the type of buffer solution in the content can be put together, while the acid-base reaction in the content contains the making of a buffer solution. Furthermore to the idea of the hydrolysis between types of salt material, the concept of hydrolysis and the hydrolysis reaction is almost similar content, in addition to these three important concepts overlapped and inverted. As an example for the concept of hydrolysis contains the types of salt based on its acid-base constituent, while the hydrolysis reaction is more appropriate included in the concept of hydrolysis. However, there is one teacher with colloidal material which order of the material was appropriate and important concept had been written all.

Once confirmed by the lesson plan written and the interview turned out to be so common, the order of the material in the lesson plan also not sorted according to the indicators or learning objectives. Thus it can be said that the depth and breadth of material not in accordance with the specified indicators. It should be noted, teachers not yet encourage students to get used to derive a formula such as the determination of pH and Ksp, and have not thought about the important concept as a prerequisite material relating primarily to the concept of equilibrium. The order of the material is associated with the prerequisites material and relates also to write apperception on the preliminary activities. In addition, it also deals with the CoRe question number 2.

CoRe Documents Question, number 2: Why is it important to know by the students?

Reason consideration the importance of the concept to be delivered, all teachers wrote that this concept relates to the concept of the next big idea. Not a single teacher who wrote the benefits of studying this concept so that it can be connected with preliminary activities that include orientation and apperception. Based on observations of the research team until now, generally both teacher and teacher candidates in writing orientation and apperception on preliminary activities only write to motivate students, but how to motivate students is not included. Similarly, almost all the written lesson plans, rarely even almost no one expressed the importance of studying the material that will be discussed. After the interview, known that the teacher having difficulty making questions and scoop out prerequisite knowledge to build new knowledge, also difficult in connecting students' prior knowledge with the material to be studied. This condition can be resolved though not optimal, the teachers will improve the writing of the next CoRe.

CoRe Documents Question, number 3: The other thing from this material that you know, but not yet known by the students?

This question relates teacher knowledge in determining the depth and breadth of the material provided, in addition to the teacher's ability to make decisions about what needs to be given and what has not yet to be given to students so that the students' knowledge is not ambiguous. For this question, none of the teachers who wrote theCoRe. If the terms of the order of how the teacher write the material on the CoRe question number 1, was detected that teachers pay less attention to the order of the material and the prerequisite materials, let alone limit of the material to be given

such thisCoRe question number 3. This fact is in contrast to teacher candidates who tried to pay attention to this problem, for example, teacher candidates wrote the following: students do not know about the stability of the elements, students not yet know about the Lewis structure.

CoRe Documents Question, number 4: Difficulties/limitations related to how to teach this material?

Difficulties of teachers in teaching important concepts different from one another, there is a review of the limitations of equipment and chemicals, the prerequisite materials, the use of formulas, and some other important concepts have no trouble. Teachers have not done the analysis of the difficulties that may arise based on the method to be used, the newly linked with a big idea. After the interview, the teacher becomes more understood and to answer the CoRe question number 4 will be corrected in the next CoRe writing, so that the writing lesson plans, especially for core activities would be better.

CoRe Documents Question, number 5: Knowledge of students' thinking that affect you in teaching this material?

This question relates to the ability of teachers in analyzing the knowledge that has been owned by the students, and in predicting the ability of students to absorb the material provided by the teacher. Relating to the lesson plan, this knowledge is found in preliminary activities (apperception), description of the learning activities, and the writing material. The condition of the students described by teachers' testimony were varied like weak in math lead to difficulty in calculating the pH of the solution, difficult to distinguish between ionization and precipitation reactions, difficult to distinguish between a strong acid and a weak acid, distinguish between the dispersed phase and the dispersing medium. If the teacher has well consider whetherprior knowledge/students' thinking condition will be able to identify misconceptions that may be experienced by students. According to Loughran (2001), this aspect is much related to the knowledge of teachers based on teaching experience. However, it turns out teacher candidates to answer this question in more detail.

CoRe Documents Question, number 6: Another factor that affects the way you teach this material?

Each teacher has a specific consideration in designing the learning conducted or teaching a material. The number of students, limited equipment and material, and the allocation of time takes into teachers' consideration and different from each other because of the different learning environment and conditions. This identification requires deep thought and the ability of teachers to associate the concept with a variety of things. However, the facts that occurred to date in the implementation of classroom learning is done withsteps of teachers start explanations, exercises, then give the problem to be done or homework. For material that is considered easy by teachers such as colloidal even students were told to read on their own, then given the task to make

summary.

CoRe Documents Question, number 7: The procedure of teaching (and the specific reasons for its use)?

Every big idea or the important concepts can be taught with different methods and different media. Teachers' knowledge in selecting model/approach/method and strategy and the right media to teach concepts with a certain indicator is an important aspect in the PCK (Loughran, 2011). A teacher propose innovative and creative learning than other teachers. Innovation held by teachers related to newly drilled learning models in this research activity, and teachers want to put into practice directly in the class corresponding to written lesson plan. Having introduced the CoRe document writing, the implementation of learning in the classroom that designed in the lesson planare to enable students through practical work and discussion groups. While before introduced with CoRe writing, generally teachers using conventional procedures that dominated by lectures, giving the example problems and exercises, although in the writing lesson plans to write a scientific approach. All teachers also found practicum conducted after the theory, and this fact suggests that in order to make students construct their own knowledge is not true. However different after writing CoRe, made practical first followed a group discussion. As an example of writing CoRe written by teacher: with the approach of Problem Based Learning in order to better understand the material and be able to prove the theory with experiment, experiment continued with discussions and exercises in groups so that discussions took place between the students who quickly understand the material with students who need more time in understand the material, and the teacher gives a little explanation then students had discussions with peer tutors.

CoRe Documents Question, number 8: The specific way to ensure students' understanding or confusion regarding this material?

A way to know that the students have grasped the material provided can be done in various ways. This question also relates to authentic assessment should be prepared for indicators in certain basic competencies and allows teachers to design a follow-up to improve the learning process. Readiness of research subject in designing an evaluation tool on the lesson plan appears from the statement in the CoRedocument as follows: Each group is represented by a student to present the results of experiments in front of the class, and students are asked to work on the problems on the board and then the teacher confirmed other solutions: through written test and done problems on worksheets as a practical guide for students, from lab reports were written.

CoRe instrument (Table 1) is the most appropriate techniques for direct recording of teachers' PCK capability. CoRe can help determine problems of content, approach/learning methods, and provokes what is important in teaching the material and why it is important. Even also help teachers to identify what needs to be known and has not to be known by the student. The biggest difficulty experienced by teacher is in determining the limits of material that must be given,

although it should not happen because of the knowledge possessed by teacher actually will guide the teachers themselves in defining the limits of material (Shulman, 1986). Another difficulty as stated by Harlen (2010) is to determine the ideas comprehensively in accordance with the curriculum, the selection of important concepts, as well as the depth and breadth of a topic.

Pedagogical content of MGMP chemistry teacher initially was limited to explaining the material in lectures and discussions. Teachers already know there are various models of learning and the media, but the teachers still do not take into account the compatibility between the materials and methods. Through the CoRe writing before preparing lesson plans and PaP-eRs after teaching teacher slowly began applying appropriate learning strategies. For example, there are implementing problem-based learning and inquiry, and experiment done before the theory for further doing group discussion in order to construct knowledge. The existence of association of teachers like MGMP is a facility for teacherstolearn by sharing their knowledge and their experiences in the classroom, school, books, the Internet, or outside the school. Community together proven to be effective in helping teachers to question the routine and examine new ideas while engaging in collaborative efforts to build knowledge (Grossman in Wilson, 2008).

PaP-eRs is a form of teacher reflection after the learning process in narrative form. This document differs from the CoRe document that can be done in groups, since PaP-eRs done individually. Based on the results of the teacher writing can be described as follows. None of the teachers who wrote the problems faced, all of them write down the problems faced by students, and none of the teachers were telling events beyond expectations. In addition to the assessment all teachers do not write down the way assessment done because it considers to be one package with lesson plans, as well as the learning stages activities is not written in detail, because it was written in the lesson plan.

Pedagogical Content Knowledge is knowledge that requires special expertise, for a teacher this knowledge is formed through a combination of in-depth mastery of content and good pedagogical knowledge so as to create an effective learning by considering various things (Loughran, 2011). Teachers should be familiar with the concept and the difficulties to be faced by the students and to organize, prepare, execute, and assess all of those are summarized in the PCK. Related to the concept there are three things which are important concepts, breadth and depth, as well as the identification of misconceptions. Misconceptions that often occurs because students' prior knowledge, teachers' teaching strategies, textbooks, and its relation to other concepts such as mathematics and physics (Tekkaya, 2003). Besides that, one important reason for their difficulty in mastering chemistry concept closely related to multiple levels of representation used in describing and explaining the chemical phenomena (Johnstone, 2000a, 2000b; Tasker & Dalton, 2006; Eilks, et.al, 2007, Chandrasegaran et.al., 2007). Mastery of learners to thechemistry concepts should be demonstrated by the ability to transfer and links between the three levels of

representation of the chemical that consists of macroscopic, submicroscopic and symbolic level (Johnston, 2000a, 200b; Treagust & Chandrasegaran 2009; Talanquer 2011; Tuysuza, et. al., 2011). Through this CoRe writing is expected to improve understanding of chemistry materials ofteacher candidates as well as how to teach it, as has been drilled through the CoRe writing numbers 4-7. CoRe has the potential to help teachers gain access to the knowledge and experience as anexpert or an experienced teacher (Eames et al., 2012).

Some of the factors that constrain the feasibility of activities are: (1) the busyness of teachers are highly dense (2) some CoRe document items is still difficult to be expressed by teacher, and this is primarily related to the weakness of the depth of the material owned by teachers, and (3) the teacher is also not accustomed to write, so that the reflection in the form of PaP-eRsneed more exercise. Factors supporting the implementation of the research is that the teacher enthusiast for this additional task because haveuseful in filling MGMP and intend to make a book that contains the CoRe documents, lesson plans, worksheets and PaP-eRs documents.

CONCLUSIONS

Based on the analysis of the study result description showed that PCK description of a teacher which analyzed through the preparation of CoRe documents and PaP-eRs correlated with improved performance of chemistry teacher in preparing the lesson plan. Some things that have been considered by the teacher before writing lesson plans and classroom practice is the breadth and depth of the material, misconceptions identification, and learning strategies so that students are able to construct knowledge. Constraints faced by teachers is mainly concerned with the busyness of teachers, lack of mastery of concepts that are owned, and the teacher has not been used to write the PaP-eRs as a reflection of what has been done. However, teachers feel happy doing CoRe document preparation and PaP-eRs as well as feel the need to be trained and the results are reproduced in order to be useful, especially for chemistry teachers in the MGMP group. To analyze the development of teachers' PCK need to do teaching practice through Lesson Study for further documented in the form of learning CD.

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