ICMSE 2015
INTERNATIONAL CONFERENCE ON MATHEMATICS, SCIENCE, AND EDUCATION
Faculty of Mathematics and Natural ScienceSemarang State University
phone: +62 248508112,+62 85876267947, +62 81805844994
email:icmse2015@gmail.com
website: icmseunnes.com

BIOLOGY TEACHERS CONTENT REPRESENTATIONS (CORES) IN CONCEPT OF HUMAN AND THE ENVIRONMENT

Lutfia Nur Hadiyanti[1] , Ari Widodo[2], Diana Rochintaniawati[2]

[1]Department of Biology, Semarang State University, Indonesia
[2]School of Postgraduate Studies, Indonesia University of Education, Indonesia

E-mail: misslutfia@gmail.com

ABSTRACT

CoRe is an instrument developed by Loughran to help assessing teacher's pedagogical content knowledge (PCK). It has been proven to effectively represent teacher's competences. The aim of this study is to explain Biology teachers' CoRes in a specific concept. The study was conducted by qualitative approach. Participants in this research were two experienced and five prospective Biology teachers from two different junior high schools in Bandung. Experienced teachers in this study were Biology majoring teachers with more than 15 years teaching experience at the same level. While the prospective teachers were undergraduate Biology students of Indonesia University of Education whose were undergoing Professionals Teacher Training Program (PLP) in the second semester of academic year 2013/2014. Both teachers *CoRes* were documented and analyzed by a coding reference. Result showed that prospective Biology teachers had more detail CoRes than the experienced teachers and categorized in upper group. While CoRes of experienced teachers which less detail were in the middle group.

Key Word: biology teachers, CoRes, PCK, human and the environment

INTRODUCTION

Science teaching needs a specific skill to deliver the content to the students scientifically. Science teachers' pedagogy will be different with other teachers. PCK has become an accepted academic construct and, as such, has been closely linked to views associated with the professional knowledge base of teachers. Loughran *et al*. (2001) define PCK which is proposed by Shulman (1987) as the knowledge that a teacher uses to provide learning environment that help learners make sense of particular science content.

PCK develops along teachers experiences. But not all teachers can reflect their action to change and improve their competences. Acquiring specific PCK requires teaching and assessing a variety of science topic experiences to a range of students. But, in the fact, experienced teachers' PCK is not always better than the new teachers'. Anwar (2014) found that there is a similarity of prospective teachers' PCK development between consecutive and concurrent approach. PCK is too complex to be captured until Loughran *et al*. (2001) developed instruments, CoRe and PaP-eR, to portray and overcome its complexity.

This study explores part of Biology teachers' PCK in concept of Human and the Environment by means using CoRe. Research in portraying PCK has been done by researcher in many ways. Young *et al*. (2012) described Technological Pedagogical Content Knowledge (TPCK) literature using confidence intervals. Jüttner *et al*. (2013) measured PCK by Rasch analysis. Using CoRes can promote and develop novice science teachers' PCK. CoRe as a form of "planning template" could help to frame teachers' thinking as they attempted to construct their own PCK for a particular topic (Hume, 2010; Williams, 2012). Research of PCK in similar topic also has been done by Çalik and Aytar (2013) who investigated six prospective primary teachers' PCK by different research design.

METHOD AND DISCUSSION

In 2001, Loughran has been using CoRe as methodology to assess teachers' understanding of the content. In this paper we explain a particular facet of PCK which is measured by CoRes. We observed seven participants which are categorized as experienced and prospective Biology teachers. Then all teachers are coded to simplify the explanation.

Experienced teachers in this study are certified Biology majoring teachers with more than 15 years teaching experience at the same level. They are coded by G1 and G2. The prospective Biology teachers are Biology department students of Indonesia University of Education who were in Professionals Teacher Training Program (PLP) in the second semester of academic year 2013/2014. Both categories are from two different junior high schools in Bandung which still applied competence-based curriculum. They are coded by M1, M2, M3, M4, and M5.

This study was conducted in qualitative approach. Data was collected from CoRe as the main instrument and equipped by interview and observation. Then focus on CoRe analysis of the participants. Before teaching the topic, teachers were asked by questions of CoRe. All teachers' answers are explained below.

1. **What do you intend to the students to learn about this topic?**

   Science content to be taught by teachers was represented by big ideas. Based on the analysis, experienced teachers' big ideas are less than prospective teachers'. de Berr (2009) stated that categorizing big ideas is accepted to be done because sometime one of big ideas is still related with another big idea. Big ideas in this study were categorized based on content description and its stressing. Big ideas of both experienced and prospective teachers are represented in **Table 1**.

Table 1. Big Ideas Category of the Teachers*

Numb	Big Idea Category	G1	G2	M1	M2	M3	M4	M5
1	Population density and the formula	√	-	√	√	√	-	-
2	Population dynamic and factors influenced	√	-	√	√	-	√	√
3	Population dynamic can be counted mathematically	-	√	-	-	√	√	√
4	Population density effects to the environment	√	-	√	√	√	√	√
5	Environmental pollution	-	√	√	√	-	√	-
6	Global warming	-	-	-	√	-	-	√
7	Solution to overcome environmental pollution	-	√	√	-	-	√	-
8	Waste recycling	-	-	-	√	-	√	-
Total		3	3	5	6	3	6	4

*Adapted from Hadiyanti (2014)

Big idea statements of the teachers were different, so that we categorized those based on the similarities. Loughran *et al*. (2001) stated that there is no provision of big ideas number. The number can be different and influenced by some aspects such as topic limitation from the teachers, time allocation, curriculum, and teaching experiences.

2. **Why it is important for students to know this?**

   Almost all teachers said that the concept was important to be taught because it is in students surrounding. Whereas, all contents in Indonesia are considered in curriculum and linked with students' daily activities. Some of participants explained specifically. M5 stated that the content is important to make students aware about environmental pollution and know how to overcome it. M1 taught population formula to increase quantitative literacy. Other prospective teachers taught the concept to stimulate students' environmental awareness.

   Experienced teachers tend to relate content taught with curriculum considering the national examination. Prospective teachers did not consider the national examination because they might have no experience in teaching for students in national examination preparation. These finding are supported by Loughran *et al*. (2001) who stated that experienced teachers will decide what topic is important based on their experiences.

3. **What is other topic related, that you do not intend students to know yet?**

   Experienced teacher stated that green house effect, acid rain and global warming were, but it is for senior high school students. G1 said that the material is still too abstract to be understood for junior high school students. Whereas, the prospective teachers tend to teach something based on theory they have learnt in lecture.

   M1 wrote natality and mortality categories did not need to be known because it is belong to another subject matter. Almost all prospective teachers did not know what actually the limitation of the topic. Teachers have to know others topic to widen their knowledge so that they will give more big ideas. It was happened in prospective teachers who just got

knowledge from lecture. Experienced teachers' other knowledge had been reduced because they learnt the same thing for years and limited by junior high school curriculum.

4. **What are difficulties/limitations connected with this teaching idea?**

Every teacher had her own difficulties in teaching the topic. The difficulty was related to the learning tool or media they will use in the classroom. Almost all teachers had the same difficulty in students' mathematical ability.

One of difficulties stated by prospective teachers was classroom management. It was not stated by experienced teachers. Loughran *et al*. (2001) revealed that without problems identification, the learning cannot be judged as constructivism learning. NSTA (2003) expected teachers to have a competency in engaging constructivism learning through science related experiences.

The finding is supported by Rochintaniawati (2011) who stated that Indonesian science teachers still need a training to conduct a science-process-skill -based learning. Teachers pedagogical construct process includes planning (which is explained in CoRe) and its implementation. Constructivism learning is a learning where teachers as facilitator stimulate students to actively construct their own knowledge (Hashweh, 2005; Kalpana, 2014)

5. **What is students' misconception which possibly affects your teaching of this topic?**

Experienced teachers conducted learning based on students' previous knowledge. Evaluation was given to students to check their mastery level of the concept. Every teacher could state students' misconception except G1. Misconception happened because wrong sciences learning process or because of illogical explanation in previous understanding (Con & Bower in da Silva & Hunter, 2009). Teachers' ability in identifying students' misconception is highly related with teachers' knowledge based on their teaching experiences in a certain topic.

6. **What other factors might influence your teaching method?**

Experienced teachers gave short statements for this question. They were also influenced by curriculum. Whereas, prospective teachers explained detail some factors which might influence their teaching. They considered teaching concept, technique, students' ability and environment. There was no prospective teacher considered the curriculum.

This question is related to second, fourth, and seventh CoRe's aspect. Other factor identification enables teacher to prepare possibilities happened in learning so that it needs a deep thinking and ability to connect the concept with many things

7. **How is your teaching procedure (and particular reasons for using these to engage with this idea)?**

Knowledge about teaching procedure is very crucial. It is because the ability to decide appropriate teaching or learning procedure to get expected learning outcome indicate a good PCK (Loughran *et al*. 2001). In this case, prospective teachers had more various teaching method, such as cooperative learning, role playing instead of explanation and discussion. Innovation by prospective teachers is related to teaching method knowledge they just got from lectures. Berry & Van Driel (2012) stated that almost all teachers tend to use conventional teaching method and failed to create meaningful learning or motivated students to learn further science learning.

8. **How is specific way of ascertaining students' understanding of confusion around this idea?**

This question is related to how teacher used methods in "assessment for learning". But almost all teachers wrote explanation about "assessment of learning". Evaluation techniques should be appropriate with topic characteristic, learning goal, and students' characteristic.

Evaluation methods conducted by teachers were mostly the same. Wilson (2008) stated that "assessment for learning" is one of important topics in developing PCK. "Assessments for learning" enable teachers to change previous CoRe's aspects to improve the learning quality and effectivity. Çalik & Aytar (2013) also support this finding and suggest that prospective teachers should be directed to more practical experiences with complementary measurement assessment during pre-service education.

9. **How do you utilize technology available in teaching this topic?**

Learning media is used to help students understand the topic. Media proposed in CoRe is media which belong to information technology. But all teachers understood it as all media used in

teaching, whether it is related to IT or not. Media for this concept is not various because it is easier and cheaper to use actual media which can be found in the natural surroundings.

Learning Medias which appeared in this study were (a) picture, (b) video, (c) internet, (d) model, and power point slides. Gao & Mager (2013) related between teachers' competency in using media with reflection level and teachers' knowledge to integrate media with the topic. Further, he divided teachers' reflection into *fragmented understanding, practical understanding*, and *embodied understanding*. Based on analysis, both experienced and prospective Biology teachers are practical understanding teachers. People who are in this stage has practical reflection where technology is rarely used and not belong to part of learning.

10. **How to overcome limitation in reaching your teaching goals?**
This question explore teachers' knowledge in solving problems might appear in learning. For example, because of limitation of multimedia room, M1 asked student to imagine and compared recent environmental condition with 10 years ago. To solve students' poor mathematical ability, M4 asked them to bring calculator. G1 asked students to read and make a paper themselves at home because of time limitation. Actually, this last question of CoRe is related with the previous questions.

Coding analysis

All teachers' CoRe was then analyzed by CoRe's scoring rubric appertaining six aspects: (a)the big ideas, (b)consideration in choosing concept, (c)limitation of concept determination, (d) students' prior knowledge and difficulty identification, (e)teaching consideration, and (f)assessment. Summary of coding is represented at **Table 2**. The analysis showed that G1, G2, M3 and M5 were in the middle category. M1, M2 and M4 were in upper category. Each category has its pattern and explanation.

Table 2. Summary of Coding Result

Teachers	G1	G2	M1	M2	M3	M4	M5
Total Coding	11	12	14	14	11	14	10

Upper category has detail CoRes. In this category teaching and learning process was done based on various aspects. Students' prior knowledge and difficulty identification was explained detail even though not specifically. CoRe in middle category was not explained detail. All big ideas proposed by teachers in this category had been covered all essential topics. Middle teachers category could not identify students' prior knowledge and difficulties so that limitation of the topic was hardly decided. Teaching learning process in this category was not explained detail.

CONCLUSION

The finding of this study showed a pattern of observed teachers' PCK for each category. Coding analysis classified all experienced teachers observed in middle category, and almost all prospective teachers observed in upper category. The results suggest that teachers should always improve and train their PCK as long as they teach to provide meaningful science learning.

REFERENCES

Anwar, Y. 2014. *Perkembangan Pedagogical Content Knowledge (PCK) Calon Guru Biologi pada Peserta Pendekatan Konsekutif dan pada Peserta Pendekatan Konkuren*. (Disertasi). School of Post-Graduate Studies, Indonesia University of Education, Bandung.

Berry, A & Van Driel, J. 2012. Teaching about Teaching Science: Aims, strategies, and backgrounds of science teacher educators. *Journal of Teacher Education*, 64(2): 117–128.

Çalik, M & Aytar, A. 2013. Investigating Prospective Primary Teachers' Pedagogical Content Knowledge of 'Effect of Human on Environment" Subject in the Process of Teaching Practice. *Educational Sciences: Theory & Practice*. 13(3): 1599-1605. DOI: 10.12738/estp.2013.3.1649.

da Silva, K.B. & Hunter, N. 2009. The Use of Pre-lectures in a University Biology Course-Eliminating the Need for Prerequisites. Bioscience education 14. from *www.bioscience.heacademy.ac.uk/journal/vol14/beej-14-2.pdf*, August 19th 2014.

de Beer, H. 2009. The Characteristics of Pedagogical Content Knowledge of Teachers Teaching an Introductory Programming Course. (Thesis). Technische Universiteit Eindhoven Eindhoven School of Education, Eindhoven.

Gao, P. & Mager, G. 2013. Constructing Embodied Understanding of Technological Pedagogical Content Knowledge: Preservice teachers' learning to teach with information technology. *International Journal Social Media and Interactive Learning Environment* 1(1): 74-92.

Hadiyanti, L.N. 2014. *Pedagogical Content Knowledge Guru Berpengalaman dan Calon Guru Biologi*. (Thesis). School of Post-Graduate Studies, Indonesia University of Education, Bandung.

Hashweh, M.Z. 2005. Teacher Pedagogical Construction: A reconfiguration of pedagogical content knowledge. *Teachers and Teaching: Theory and practice* 11(3): 273-292.

Hume, A. 2010. CoRes as Tools for Promoting Pedagogical Content Knowledge of Novice Science Teachers. *Chemistry Education in New Zealand*. May 2010: 13-19.

Jüttner, M., Boone, W., Park, S., Neuhaus, B.J. 2013. Development and Use of a Test Instrument to Measure Biology Teachers' Content Knowledge (CK) and Pedagogical Content Knowledge (PCK). *Educational Assessment, Evaluation and Accountability* 25(1): 45-67. DOI 10.1007/s11092-013-9157-y.

Kalpana, T. 2014. A Constructivist Perspective on Teaching and Learning: A conceptual framework. *International Research Journal of Social Science*, 3(1): 27-29.

Loughran, J., Milroy, P., Berry, A., Gunstone, R., Mullhall, P. 2001. Documenting Science Teachers' Pedagogical Content Knowledge through PaP-eRs. *Research in Science Education*, 31: 289-307.

[NSTA] National Science Teachers Association. 2003. Standards for Science Teacher Preparation. http://www.nsta.org/preservice/2003stds.aspx

Rochintaniawati, D. 2011. *Analisis Kebutuhan Guru dalam Mengembangkan Kurikulum dan Pembelajaran IPA di Sekolah Dasar* (Dissertation). Universitas Pendidikan Indonesia, Accessed from http://a-research.upi.edu/disertasiview.php?no_disertasi=153

Shulman, L. 1987. Knowledge and Teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1): 1-22.

Williams, J. 2012. Using CoRes to Develop the Pedagogical Content Knowledge (PCK) of Early Career Science and Technology Teachers. *Journal of Technology Education* 24(1): 34-53.

Wilson, N.S. 2008. Teachers Expanding Pedagogical Content Knowledge about Formative Assesment Together. *Journal of In-service Education*, 34(3): 283-298.

Young, J.R., Young, J.L., Shaker, Z. 2012. Technological Pedagodical Content Knowledge (TPACK) Literature Using Confidence Intervals. *TechTrends*, 56(5): 25-33.