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# Development of Content Representation (CoRe) Framework as Analysis Instrument of Pedagogical Content Knowledge Capability for Biology Teachers

HRA Mulyani<sup>1</sup>, Anisa Zahra Hermayani<sup>2</sup>

<sup>1,2</sup> Biology Education, Universitas Muhammadiyah Metro, Metro, Indonesia

Correspondence: Jl. Ki Hajar Dewantara No. 116 Iringmuyo, Metro, Lampung.  
E-mail: hra.mulyani@gmail.com

## Abstract

The results of the preliminary study were obtained from 15 prospective biology teacher students related to the initial abilities that must be possessed to become a teacher and the implementation of learning in science learning. In general, 15 prospective teachers were of the opinion that it was not so different about the ability to have to become a teacher. Based on the results of the preliminary study, prospective teacher students already know the abilities that need to be possessed to become a teacher and in the implementation of learning students must be active but still not showing knowledge related to knowledge that combines content and pedagogical knowledge. One way to analyze the ability of prospective teacher PCK is through filling in documents consisting of Content Representation (CoRe). The data presented in the form of student response questionnaire analysis related to CoRe in terms of education and language and the results of test the validity and reliability of items. For linguistic aspects of CoRe instrument in general CoRe instrument have very high frequency, meaning that CoRe instrument that have been developed are able to be accepted and used properly by prospective biology teacher students at Muhammadiyah Metro University with a percentage 70%. For educational aspects of the CoRe instrument in general CoRe instrument have very high criteria, meaning that the CoRe instrument that have been developed are able to be accepted and used properly by prospective biology teachers at the Muhammadiyah Metro University with a percentage 73,33%.

**Keywords:** CoRe, Pedagogical Content Knowledge, Biology Teacher

## 1. Introduction

The teacher is one of the determining factors for the success of the learning process. (Arends, 2007)states that there are 7 categories of domains of knowledge that are important to be mastered by a teacher in order to carry out learning properly, including knowledge about: (a) Content Knowledge; (b) Pedagogical Content Knowledge;

(c) Knowledge of Learners; (d) General Pedagogical Knowledge; (e) Knowledge of Educational Context; (f) Curriculum Knowledge; and (g) Knowledge of Educational ends, purposes, and values.

One of the important knowledge for teachers is *Pedagogical Content Knowledge* (PCK). PCK it is very important for a teacher to create meaningful learning for students. (Abbitt, 2011) states that PCK is knowledge about pedagogy, learning practices and lesson planning, as well as appropriate methods to teach a material. PCK is important knowledge in the process of developing science literacy and the ability to transform teacher knowledge into the learning process as an agent of change, teachers should continue to develop their teaching process in the classroom and prospective teachers continue to train their skills in designing lessons, one of which is to understand PCK. Since PCK was introduced, many educational researchers have studied PCK, including science teachers (Brown et al., 2013; Van Driel, 2010). Their findings indicate that PCK is knowledge, experience, and expertise acquired through classroom experiences.

The Biology Education Study Program, Faculty of Teacher Training and Education, Universitas Muhammadiyah Metro is one of the LPTKs (Educational Staff Educational Institutions) with the main profile of graduates being prospective biology teachers. As a producer of biology teacher candidates, graduates of Biology Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Metro are expected to have competencies as stated in the Study Program Learning Outcomes, one of which is being able to apply specific pedagogy to teach biology concepts by considering the characteristics of the concept and pedagogy that are appropriate as the implementation of Pedagogical Content Knowledge (PCK). In order to obtain these work skills, prospective biology teacher students must at least have knowledge of: (1) biological concepts, principles, laws, and theories to be applied in learning biology in schools and in the community; and (2) philosophy of approaches, models, methods, and instructional media in order to carry out biology learning in schools and the community.

Based on the results of the preliminary study obtained from 15 prospective biology teacher students regarding the initial abilities that must be possessed to become teachers and the implementation of learning in science learning, in general 15 prospective teachers have no different opinion regarding the abilities that must be possessed to become a teacher, 11 people prospective teachers argued that becoming a teacher is not easy because the abilities that teachers need to have are not only content knowledge but also need to have other knowledge, namely pedagogy, while 4 prospective teachers argue that being a teacher is not difficult because the ability that needs to be possessed is only content knowledge. Opinions of 15 prospective teachers related to the implementation of learning in class, 6 of them argued that in the learning process there was a need for interaction between teachers and students so there was a need for learning methods that provoked active students in learning, while 2 prospective teacher students argued that in the implementation of teacher learning not only conveying the material but also educating students to behave well, and 7 prospective teacher students only thought that in the implementation of learning students must be active. Based on the results of the preliminary study, prospective teacher students already know the abilities that need to be possessed to become teachers and in the implementation of learning students must be active but still have not shown knowledge related to knowledge that combines content knowledge and pedagogy.

One way to analyze the PCK ability of prospective teachers is through filling out a document consisting of Content Representation (CoRe). CoRe is used as a document to analyze the PCK abilities of prospective teachers because it can make explicit the relationship between content knowledge, teaching and learning for science teachers (Hume, 2010; Loughran et al., 2012). The CoRe format is a table consisting of rows and columns. The top row represents "Main Ideas" which are intended to represent the main ideas and concepts that are in a particular science content area (Loughran et al., 2012). Based on expert opinion regarding CoRe, it can be said that through CoRe, prospective teacher students can plan activities in the learning process that match the content of the material being taught with their pedagogy. CoRe can make prospective teachers better prepared to teach material in terms of content and teach it.

Since the enactment of the new policy, namely the preparation of lesson plan Curriculum 2013 only contains KI and KD Attitude of Knowledge and Skills except for Religion and PPKn subjects which also contain KI and KD

for Spiritual and Social Attitudes, so it is necessary to develop a CoRe instrument to analyze the PCK of teachers in planning lessons. Therefore, in this study it is necessary to develop a CoRe instrument for Biology teacher candidates as an instrument for analyzing the PCK abilities of prospective Biology teacher candidates.

## 2. Method

This research is a type of research and development or Research and Development (R&D). In this study, the development of the CoRe Instrument was adopted from (Loughran et al., 2012) as an instrument for analyzing the ability of the Pedagogical Content Knowledge for Biology Teacher Candidates at Faculty of Teacher Training and Education, Universitas Muhammadiyah Metro. The development procedure carried out in this study according to (Borg & Gall, 1989) consists of the following steps:

1. *Research and information collecting.* Research and data collection includes preliminary studies. The preliminary study was carried out in two ways, namely needs analysis and literature study.

### a. Needs Analysis

The needs analysis carried out was conducting a preliminary study by distributing questionnaires and interviews related to the abilities that must be possessed to become a teacher and the implementation of biology learning with 15 prospective teacher students who have taken the micro-teaching course at Faculty of Teacher Training and Education, Universitas Muhammadiyah Metro.

Table 1: Results of Preliminary Study Needs Analysis

No	Aspect	Teacher Candidate Response
1	The abilities a prospective teacher must have	<ol style="list-style-type: none"> <li>a. 73,33% argues that prospective teachers need to have content and pedagogical abilities</li> <li>b. 26.67% argues that prospective teachers only need content skills</li> </ol>
2	Implementation of learning in learning Biology	<ol style="list-style-type: none"> <li>a. 40% argues that the Biology learning process has a two-way interaction with the right method</li> <li>b. 13,33% argues that in the learning process the teacher does not only teach but also educates student behavior</li> <li>c. 46,67% argues that in the implementation of student learning must be active.</li> </ol>

### b. Study of literature

In the literature study there are several theories about PCK according to experts including Lee S Shulman in his book entitled *Knowledge and teaching: Foundation of the New Reform*, and Magnusson, S., Krajcik, J., & Borke, H, in his book, *Nature , sources, and development of pedagogical content knowledge for science teaching*, while the theory of CoRe has several theories including Loughran, J., B. Amanda, & M. Pamela in his book *Understanding and Developing Science Teacher's Pedagogical Content Knowledge 2nd Edition* and Hume, A., & Berry, A. in their book *Constructing CoRes - a strategy for building PCK in pre-service science teacher education*.

2. Planning namely compiling an instrument development plan, including determining the main literature developed into a CoRe instrument, formulating objectives to be achieved by research, and determining the scope for developing the instrument.

### a. Main Literature Determination

The main literature used as a reference for developing the CoRe instrument is as follows:

Table 2: Main Literature Details

No	Essential Concepts	Author	Main Literature
1	CoRe	Loughran, J., B. Amanda, & M. Pamela	<i>Understanding and Developing Science Teacher's Pedagogical Content Knowledge</i> 2nd Edition
2	PCK	Magnusson, S., Krajcik, J., & Borko, H	<i>Nature, sources, and development of pedagogical content knowledge for science teaching</i>

Apart from the two books, the main reference in this research is the RPS or Semester Learning Plan in the Micro Teaching course.

#### b. Formulation of Purpose

Based on the needs analysis that has been carried out, the purpose of this research is to produce a CoRe instrument that is able to measure the PCK ability of a Biology Teacher Candidate in order to maximize the PCK abilities possessed and to determine the Biology Teacher Candidate's response to the instruments that have been developed.

#### c. Scope of Development

The development of the CoRe instrument is a document that is developed from a teacher candidate's answer to a big idea related to how to teach the main idea. This CoRe instrument was made for Biology Teacher Candidates at Muhammadiyah Metro University.

3. Develop preliminary form of product. Product development begins with making the CoRe instrument grid to be developed and the Respondent Trial instrument.

#### a. Lesson Plan Analysis

Lesson Plan analysis begins by looking at the learning objectives, so that it can be seen the competencies that will be achieved in the learning. The core objective of micro teaching-learning is to provide provisions in the form of understanding concepts about education and subject matter, as well as training prospective teacher students to be skilled in applying learning concepts in actual learning activities.

Understanding educational concepts and subject matter can also be called PCK or Pedagogical Content Knowledge. To be able to see the PCK of prospective teacher students, a tool is needed that can measure how much the prospective teacher's understanding of educational concepts and subject matter. The instrument that can measure PCK is the CoRe instrument. CoRe is an instrument that provides an overview of how teachers conceptualize certain subject matter content.

#### b. CoRe Instrument Development criteria

Table 3: Instrument CoRe Criteria

Learning objectives	PCK components	Indicators Assessment	Core Item Number
Train and provide understanding to prospective teacher students so that they are able to plan	Orientation to teaching Science	The concept that students must master	1,2
	Knowledge of science curriculum	The reason the importance of the main idea is raised	3,4
		Material restrictions	5,6

learning/learning tools such as syllabus, Semester Programs, Annual Programs, RPP, LKS, Teaching Materials, Media and Assessment of student learning properly and correctly	Knowledge understands the ability of students in learning science  Knowledge of learning strategies for teaching science  Knowledge of scientific assessment	Students' initial knowledge  Difficulties and limitations in teaching Factors affecting learning Learning procedure Learning Media How to assess student abilities Specific assessment of student understanding	7,8  9,10 11,12 13,14 15,16 17,18 19,20
<b>Total</b>			<b>20</b>

The initial development of the CoRe instrument was to create a grid as described in the table above. This initial draft will be validated by expert lecturers to obtain instrument validation data. The results of the validation will be translated at the revision stage.

4. Validate product testing. Initial product validation was carried out with two test subjects, namely validation by education experts (2 people) and linguists (2 people) as many as 4 people. During the initial product trial, an assessment and comments and suggestions were made on the CoRe instrument. Each expert was given a draft of the CoRe instrument that was developed and a questionnaire containing the assessment and also the advice of each expert from education and language. Suggestions given by the validator will be reconsidered whether the instrument is revised or not, while if the four validators state that the aspects of the instrument are appropriate, there will be no revisions to those aspects.
5. Main product revision, namely improving or perfecting the test results.
6. Main product testing. Conducting trials in 1 group of micro-teaching with 10 test subjects. During the field trial, prospective teachers worked on the CoRe instrument that had been developed, then the results of the trial were analyzed from the aspects of language and education.
7. Operational product revision, namely perfecting the results of field tests.
8. Operational field testing. Conducted in 3 groups of micro-teaching involving 30 subjects. Testing was carried out through the CoRe instrument, interviews, and analysis of the results.
9. Final product revision. Improvements are based on input from field implementation tests.
10. Dissemination and implementation, namely reporting the results in professional meetings in submitting national journals.

### 3. Results

The data presented is in the form of an analysis of student response questionnaires related to the CoRe instrument. The CoRe instrument, which has been validated by education experts and linguists, is tested in small groups using a student response questionnaire seen from the educational and linguistic aspects. The subjects or samples in this test were 30 people in one micro teaching class.

- a. Linguistic Aspects

This data provides information about student responses to the CoRe instrument in terms of language. The results of student response data processing are presented in Table 4 below:

Table 4: Student Response from Linguistic Aspects

Criteria	Frequency	%
Very High	21	70%
High	9	30%
Medium	0	0%
Low	0	0%
Very Low	0	0%

Based on table 4, the linguistic aspect of the student biology teacher-student response questionnaire to the CoRe instrument, which states that the language aspect is "very high" there are 21 students with a percentage of 70%, stating "high" there are 9 students with a percentage of 30%, while for the "medium "category No subject selected.", " Low " and " very low ". From the results above, it can be interpreted that the student's response to the CoRe instrument from the linguistic aspect can be categorized into very high criteria with a percentage of 40%.

#### b. Educational Aspect

This data provides information about student responses to the CoRe instrument from an educational perspective. The results of student response data processing are presented in Table 5 below:

Table 5: Student Response from the Aspect of Education

Criteria	Frequency	Presentase
Very High	22	73,33%
High	8	26,67%
Medium	0	0%
Low	0	0%
Very Low	0	0%

Based on table 5, the educational aspect of the student response questionnaire of biology teacher candidates to the CoRe instrument, which states that the language aspect is "very high", there are 22 students with a percentage of 73.33%, stating "high" there are 8 students with a percentage of 26.67%, while for the category "medium", "low" and "very low" no subject chose. From the results above, it can be interpreted that the student's response to the CoRe instrument in the educational aspect can be categorized in very high criteria with a percentage of 70%.

## 4. Discussion

Based on the results of data analysis from various product trials that have been carried out, the results of the development of the CoRe instruments to analyze the PCK of biology teacher candidates with the subject of 30 biology teacher prospective students who are taking micro teaching courses at Universitas Muhammadiyah Metro, can be categorized by category good, but there are still some shortcomings that need to be revised to improve the quality of the CoRe instruments for the better. Some of the shortcomings were revised, including:

1. Linguistic aspects
  - a. The style of presentation tends to be boring
  - b. There are still words that are difficult to understand
2. Educational aspects
  - a learning device, because it is limited by the scope of the material

Based on the results of product trials that have been carried out, the CoRe instrument and the one developed are considered to be quite good and can be used well by prospective biology teacher students at Faculty of Teacher Training and Education, Universitas Muhammadiyah Metro. The percentage value of the CoRe instrument from the language aspect was 60% and from the educational aspect was 70%.

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