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Context-based content representation, curriculum understanding, and self-efficacy: a correlation study on pre-service chemistry teacher

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Abstract. CoRe is one of the Pedagogical Content Knowledge (PCK) representation that it important for pre-service chemistry teacher. This study aimed to analyze the correlation among pre-service teachers' understanding of curriculum (UC), understanding of context-based learning (UCB), self-efficacy (SE) and the ability for designing Content Representation context-based chemistry (CoRe-CBC). A correlational study was conducted on 41 pre-service chemistry teacher of postgraduate program. Pre-service teachers' understanding of curriculum was assessed using a 30-item of multiple choices. The 6-open ended questions were used to measure the understanding of context-based chemistry learning. Students' self-efficacy was assessed by a questionnaire with 18 items. A group of experts confirmed the construct and face validity of all the instruments. Data analysis used Pearson correlation and regression. The result showed a high correlation between UCB and ability for designing the CoRe-CBC also with UC. A low correlation occurred between UC and the ability for designing CoRe-CBC. The variable of UCB had the biggest effect on the pre-service teacher ability for designing CoRe-CBC. However, the pre-service chemistry teacher still had less understanding in context-based chemistry learning. This study suggests that pre-service teachers' understanding of curriculum and context-based chemistry learning should be improved. It will useful to support the implementing context-based chemistry learning.

1. Introduction

The essence of chemistry education lies in the quality of classroom learning. Teacher has a main role on chemistry learning. So, chemistry teachers whom competent and highly committed are needed for improving the chemistry learning quality. The students may get a good achievement on a particular topic such as chemistry depending on the teacher. A good competence in transferring knowledge, values, and skills from the professionalized chemistry teacher could make a better achievement gained by the students. Thus, the development of professionalized chemistry teacher could be improved and starting from the pre-service chemistry teacher program.

As a professionalized, the chemistry teacher could have some sufficient competencies. Pre-service chemistry teachers are required to have a good chemistry understanding of subject matter who taught and how to teach it. The pre-service chemistry teachers should have pedagogical knowledge. This pedagogical knowledge could be adopted correctly on the particular chemical contents. Pedagogical Content Knowledge (PCK) was introduced by [1] to develop the professionalism of pre-service



chemistry teacher through introducing the new forms of teacher knowledge that integrates the content and pedagogical knowledge. One of the PCK representations that it is important for pre-service chemistry teacher is CoRe. The CoRe contains of a set idea about particular topic and combined with pedagogical questions is used to describing the expert teachers' PCK related to the lesson in certain topic. CoRe as a model representation of PCK was developed by [2] and according to the result of [3] work, the used of CoRe could help the pre-service science teacher in understanding PCK and develop their representations of the science content in this topic. Thus, the use of CoRe could help the student and the teacher obtain a good view about how to teach science and how to teach for students' understanding. In addition, a study conducted by [4] showed that the constructing CoRe training which assisted by proper scaffolding could promote the increasing of PCK of the novice teacher. This fact leads the pre-service chemistry teacher could be constructing the CoRe. The ability of pre-service teachers in preparing CoRe is very important as a form of readiness of teachers in preparing quality chemistry learning.

The ability to construct the CoRe may be predicted by several factors. These cover the understanding of curriculum knowledge, understanding of chemistry topic, understanding of learning component such as learning approach and model, learning source and media, also some aspects of pre-service teacher personality. The curriculum knowledge presented by the teacher would have an impact toward the teacher ability in applying the curriculum in the chemistry learning [5]. The teacher could understand the curriculum knowledge in order to get an optimum competence in making the chemistry learning effective and efficient on the transfer of chemistry content. Thus, the understanding of curriculum knowledge could lead the pre-service chemistry teacher had a good ability in constructing the CoRe of chemistry topic.

On the other hand, some changing of the chemistry curriculum occurred in a country which was introduced the context-based learning [6]. A context-based learning on chemistry topic could correlate the content of chemistry with the real life situation in order to make meaningful learning. The context was used as a starting point of chemistry learning. Context-based chemistry curriculum implies a teacher's new role to condition the content in the context settings. The ability of pre-service teachers in preparing CoRe for chemistry learning in a vocational context is still low [7]. The main difficulty encountered by pre-service teachers was predicting students' difficulties in learning the content and ensuring the students' understanding. Lack of the understanding and experience of pre-service teachers related to chemistry learning in vocational schools became the main obstacle. It may be also happening in the implementation of context-based chemistry learning for senior high school.

In addition, the self-efficacy of pre-service chemistry teacher could be enhancing in order to obtain effective chemistry learning started from learning preparation. The self-efficacy showed a person's belief that they have the sufficient skills to do some task successfully. Exercises and assignments of CoRe preparation can improve the self-efficacy of most pre-service teachers in teaching context-integrated chemistry [8]. It means that the self-efficacy of pre-service chemistry teacher may have relation to the ability in preparing CoRe as one of PCK representations. Thus, self-efficacy measurement can be used as a predictor of readiness of chemistry teacher candidates in implementing context-based chemistry learning in schools. Studies of self-efficacy and the ability of pre-service chemistry teacher to develop context-based CoRe chemistry were needed to support the effective implementation of context-based chemistry learning in schools.

Hence, this study was aimed to analyze the correlation among pre-service teachers' understanding on curriculum and context-based learning, self-efficacy, and ability in designing CoRe. The following research question guided the study: How were the correlation among the pre-service chemistry teachers' ability for designing CoRe-CBC and UC, designing CoRe-CB and UCB, designing CoRe-CBC and SE, UC and UCB, UC and SE; and UCB and SE? How much were the effect of UC, UCB and SE toward the ability for designing CoRe-CBC?

2. Methods

2.1. Research design and subject

A correlational study had conducted with four variables. The ability to design CoRe-CBC was as a dependent variable. There were three of independent variables include the UC, UCB and SE. The subjects of this study were 41 pre-service chemistry teachers enrolled on a curriculum design course in postgraduate program. Each of pre-service chemistry teachers designs the CoRe-CBC on electrochemistry and chemical equilibrium topic.

2.2. Data collection instrument

There were four instruments used to measure all research variables. First, the multiple choices test with 30-item was used to collect the CU data. The 6-open ended questions were used to measure the UCB. The data of SE was assessed by scale with 18 items. The data of ability for designing CoRe-CBC was collected by CoRe rubrics. A group of experts confirmed the construct and face validity of all the instruments.

The multiple choices test consist of several concept of curriculum such as the basic concept of curriculum (3 items), the principal in developing curriculum (4), curriculum concept model (3), high school curriculum (8), vocational school curriculum, and the curriculum implementation. Table 2 present the distribution of the curriculum knowledge instrument.

The open-ended questions of UCB were developed from the concept of the chemistry context-based learning implementation [9-12]. The concepts cover the nature of context-based learning, basic learning theory, the objective of context-based learning, the component of the context-based learning implementation, the appropriate model/method to support context-based chemistry learning; and the context that can be used in the chemistry learning.

The self-efficacy scale was constructed based on the elaboration and adaptation from The Science Teaching Efficacy Belief Instrument-Pre-service (STEBI-B) which proposed by [13] and reexamine by [14]. The instrument statements were developed according to the framework of context-based chemistry learning. There are two dimensions of SE namely Personal Science Teaching Efficacy Belief (PSTE) and Science Teaching Outcome Expectancy (STOE). The initial scale consisting of 24-items with five Likert type scales. After the validation step, as many as 6-items of self-efficacy scale was not valid. Hence, a total of 18-items of self-efficacy scale was used to measure the pre-service chemistry teachers' self-efficacy. These 18-items of self-efficacy questionnaire had the reliability of Cronbach's alpha value of 0.848.

CoRe rubrics were constructed based on the questions of pedagogic aspect [2] and added by the questions about the context which used as a starting point in the chemistry learning. These starting point was the characteristic of context-based learning [15-18]. The questions related to the intend of idea to learn, the importance, the idea that students to know yet, difficulties to teach the idea, students thinking, teaching procedure and the ways of ascertaining students understanding and confusion

2.3. Data Analysis

The statistics of Pearson Correlation was used to analyze the correlation of the pre-service chemistry teacher of the ability in designing the CoRe-CBC toward UCB, UB, and SE. In addition, regression analysis was used to analyze the effect of each predictor toward the ability for designing CoRe-CBC. Moreover, the percentage of pre-service chemistry teachers' self-efficacy on constructing CoRe is examined by dividing the score obtained with the ideal score.

3. Results and Discussion

The ability of pre-service chemistry teacher for constructing CoRe-CBC was predicted by the ability to understand the curriculum, the ability to understand the context-based learning, and the pre-service chemistry teachers' self-efficacy. The relationships of these three predictors were calculated toward the ability on constructing CoRe. The descriptive statistics of this research shown in Table 1.

Table 1. The results of descriptive statistics

| Variable | Mean | Mean Category | Maximum Ideal Score | Standard Deviation | N |
|----------|--------|---------------|---------------------|--------------------|----|
| CoRe-CBC | 68.024 | Good | 100 | 13.277 | 41 |
| UC | 72.366 | Good | 100 | 9.838 | 41 |
| UCB | 48.268 | Sufficient | 100 | 8.441 | 41 |
| SE | 69.024 | Good | 90 | 4.671 | 41 |

According to Table 1, the ability of pre-service chemistry teacher for designing CoRe-CBC was good. The same result was shown on the pre-service chemistry teacher in understanding the curriculum and pre-service chemistry teacher self-efficacy. The result of this study confirmed the previous study conducted by [19] that the understanding of curriculum knowledge brings the pre-service chemistry teacher ability to make the relationship between the topics in constructing the students' prior knowledge and the topics which be studied in the future. Other study stated that pre-service chemistry teacher still have weaknesses in preparing CoRe on curriculum knowledge components, learning strategies, assessment and mastery of chemical content [20].

In addition, the self-efficacy provides the pre-service chemistry teacher have a good ability in constructing CoRe-CBC because they have enough knowledge about the content. But, different result was observed on the pre-service chemistry teacher understanding of context-based learning. They have only a sufficient category on the understanding of context-based learning. The pre-service chemistry teacher in this study have a lack knowledge about context-based learning. They have difficulties in correlate the chemistry concept they have with the daily life issues. The understanding of the curriculum knowledge, understanding of context-based learning, and the role of self-efficacy may predict the result of the pre-service chemistry teacher ability for designing CoRe-CBC. The correlation of these three predictors on constructing CoRe-CBC were calculated by the statistics. The Pearson correlation statistics analysis result was presented in Table 2.

Table 2. The results of Pearson correlation

| | | CoRe-CBC | UC | UCB | SE |
|------------------------------|----------|----------|-------|-------|-------|
| Pearson Correlation | CoRe-CBC | 1.000 | 0.349 | 0.623 | 0.435 |
| | UC | 0.349 | 1.000 | 0.616 | 0.227 |
| | UCB | 0.623 | 0.616 | 1.000 | 0.269 |
| | SE | 0.435 | 0.227 | 0.269 | 1.000 |
| Sig. (1-tailed) ^a | CoRe-CBC | - | 0.013 | 0.000 | 0.002 |
| | UC | 0.013 | - | 0.000 | 0.077 |
| | UCB | 0.000 | 0.000 | - | 0.045 |
| | SE | 0.002 | 0.077 | 0.045 | - |

^astatistical significance level of 0.05

Based on Table 2, it can be concluded that the understanding of context-based chemistry learning had a high correlation coefficient toward the ability for designing the CoRe-CBC (0.623) and the understanding of curriculum (0.616). The CoRe constructing in this study is based on the concept of context-based learning. Hence, a good understanding of context-based learning could make the ability in constructing CoRe is increasing. The context-based learning provides an easier way to correlate the content with the real life problems [17, 21-22]. Meanwhile, the understanding of curriculum knowledge bring the pre-service chemistry teacher have a good overview about the context-based learning. The ability in analyzing the essential content on the context-based learning would improve the understanding of pre-service chemistry teacher about the curriculum knowledge [6].

On the other hand, a low correlation occurred between the understanding of curriculum and ability for designing CoRe-CBC (0.349). The understanding of curriculum knowledge didn't give direct effect

toward the pre-service chemistry teacher ability for designing CoRe-CBC. The curriculum knowledge in this study is a common understanding, so it only has a low correlation toward the ability for designing CoRe-CBC.

In addition, the pre-service teacher self-efficacy also had a low correlation toward the understanding of curriculum knowledge (0.227) and understanding of context-based learning (0.269). The pre-service chemistry teacher doesn't have enough confident in designing chemistry learning. They have a lack of understanding about context-based learning. Hence, they find difficulties in understanding the curriculum knowledge.

Different result was obtained between the correlation of pre-service chemistry teacher self-efficacy with the ability for designing CoRe-CBC which has a high correlation (0.435). Have a good prior knowledge about the chemistry content bring the pre-service chemistry teacher have a good confident for designing CoRe-CBC. Thus, a high correlation between pre-service chemistry teacher self-efficacy with CoRe-CBC is obtained. It was in line with previous study that stated self-efficacy of pre-service chemistry teachers affects their ability to implement CoRe in the learning [20]. Moreover, the effect of each predictor toward the CoRe was observed using regression analysis which the equation was presented in the Equation 1 as follow

$$Y = -26.682 - 0.115X_1 + 0.958X_2 + 0.837X_3 \quad (1)$$

Y = CoRe; X_1 = curriculum; X_2 = context-based learning; X_3 = self-efficacy

According to Equation 1, the understanding of the curriculum knowledge had a negative effect toward the ability in constructing CoRe-CBC. Different result was obtained from the understanding of context-based learning and pre-service chemistry teacher self-efficacy, which gives a positive effect toward their ability in constructing CoRe-CBC. Hence, if the understanding of the curriculum is increase one point, so the ability of the pre-service chemistry teacher in constructing CoRe-CBC would decrease as many as 0.115. In contrast, if the understanding of the pre-service chemistry teacher and self-efficacy is increase one point, their ability for designing CoRe-CBC also increase about 0.958 and 0.837 respectively. Moreover, the amount of the predictor contribution toward the ability for designing CoRe-CBC is presents on the Table 3.

Table 3. Predictor contribution toward CoRe

| Predictor | Contribution (%) | T | P-value |
|---------------|------------------|--------|---------|
| Curriculum | 0.722 | -0.561 | 0.578 |
| Context | 35.640 | 3.871 | 0.000 |
| Self-efficacy | 8.644 | 2.362 | 0.024 |

*statistical significance level of 0.05

Based on Table 3, the pre-service chemistry teacher understanding on the context-based learning gives the highest contribution toward CoRe-CBC compared to the other two predictors. While the pre-service chemistry teacher understanding gives the smallest contribution toward CoRe-CBC. This fact is support the result of the regression analysis.

Considering the context-based learning has a good role toward the ability of pre-service chemistry teacher for designing CoRe-CBC, it is necessary to enhancing the understanding of pre-service chemistry teachers about context-based learning. The pre-service chemistry teacher could have a good understanding about curriculum knowledge first. Because, a good understanding about curriculum knowledge leads the pre-service chemistry teacher has a good view about context-based learning. A good view about context-based learning may bring the pre-service chemistry teacher has enough self-efficacy beliefs. Hence, the pre-service chemistry teacher in the ability on constructing CoRe-CBC is better.

4. Conclusion

A high correlation occurred between UCB and ability for designing the CoRe-CBC also with UC. A low correlation occurred between the understanding of curriculum and the ability in designing CoRe. The variable of UCB had the biggest effect on the pre-service teacher ability for designing CoRe-CBC. However, the pre-service chemistry teacher only has a sufficient understanding in context-based chemistry learning. Hence, this study suggests that pre-service teachers' understanding of curriculum and context-based chemistry learning should be improved. It will be useful to support the implementing of context-based chemistry learning.

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