Exploration of pre-service chemistry teacher's ability in constructing context-based content representation on electrochemistry topic

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Abstract. The study aims to explore the pre-service chemistry teacher ability in constructing context-based Content Representation on Electrochemistry topic (Cb-CoRe-E). Due to the exploration of pre-service chemistry teacher ability in constructing Cb-CoRe-E, this research adopted a descriptive study with quantitative approach. A total of 20 pre-service chemistry teacher enrolled on Curriculum course were the subject of this research. The data of pre-service chemistry teacher ability in constructing Cb-CoRe-E were collected according to the document which consist a questions on pedagogical aspect. As many as 9 indicators were used as a references to be explored the pre-service chemistry teacher ability in constructing Cb-CoRe-E. The data of pre-service chemistry teacher ability were analysed according to descriptive quantitative technique by classifying the mean score obtained into five categories from very good to bad. The result of this study showed that the pre-service chemistry teacher ability in constructing Cb-CoRe-E was good. It can be concluded that pre-service chemistry teacher were ready to conducted a good chemistry learning. The pre-service chemistry teacher in the future is expected applying CoRe in every learning to promote students'chemistry meaningful learning.

2.1. Introduction

The essence of chemistry education lies in the quality of learning in the classroom. Studies shown that teacher quality becoming the most contributing factor in successfully of chemistry learning. It means that teachers are considered as the most important factor that determines the quality of chemistry education [1-5]. Chemistry teachers who are competent and highly committed to quality are demands for the realization of high quality chemistry learning.

Professional and pedagogic competencesare the qualifications that should be possessed by chemistry teachers in Indonesia. Pre-service chemistry teachers are required to have a good understanding of chemistry as the subject matter that must be taught and how to teach it. Some researchers use the term content knowledge to conceptualize the professionalism of teachers in mastering the subject matter in their classroom. A good content knowledge is a strong foundation for pre-service teachers to be able to teach chemistry effectively. Some studies show the importance of teacher's content knowledge in developing quality chemistry learning. Mastery of content knowledge has a positive influence on teaching effectiveness, being the main key on developing teacher professionalism and correlating strongly with the ability of how teachers teach appropriate chemistry content [5-9].

The way teachers delivering content influences the things students learn, so that the teacher's teaching methods cannot be separated from related content [10]. In the other words, teacher should have pedagogical knowledge that could be implemented appropriately on the certain chemistry content

[11].state that content knowledge and pedagogical knowledge should be integrated into learning process to create a new knowledge, called Pedagogical Content Knowledge (PCK). PCK is part of the slice between pedagogical knowledge and content that helps teachers understand how to teach content. The previous study [12] developed the Content Representation (CoRe) model as one of the chemistry teacher's PCK representations. CoRe is a document that presents an overview of important ideas or concepts from a content that will be taught and developed based on the questions of pedagogy aspects[12]. CoRe development could help pre-service teachers to study the content critically and explore the difficulties experienced in understanding the chemistry content that will be taught.

PCK as a specific new knowledge is needed by pre-service chemistry teachers as a provision to prepare themselves to become professional teachers. One study[13] conducted a research of the constructingCoRe as astrategy to buildpre-service chemistry teachers'PCK. The study was conducted with a case study into nine chemistry education students. The research result indicated that the constructing CoRe exercise followed by appropriate scaffolding during the constructing CoRe process enables the development of PCK for beginner teachers. The ability of pre-service teachers in constructing CoRe is very important as teacher readiness in preparing quality chemistry learning.

The trend of chemistry curriculum changing occurs with the development and introduction of contextbased education [14-15]. Context-based chemistry education adopts the view that chemistry content must be associated with reality, evolving, flexible and not merely a set of rules and principles to remember. Context is used as the starting point in learning. This contextbased chemistry curriculum has implications for a new role of a teacher in the relation with students for conditioning content in context settings. The ability of pre-service chemistry teachers in constructing CoRe for chemistry learning in vocational contexts is still low [16]. The main difficulties encountered by pre-service teachers were predicting student's difficulties in learning content and ensuring their understanding. The lack of understanding and experience of pre-service teachers regarding chemistry learning process in vocational schools becomethe main obstacle.

The implementation of context based chemistry learning is broader for the context in high school. Pre-service chemistry teachers still have weaknesses in constructing CoRe in the components of curriculum knowledge, learning strategies, assessment, and mastery thechemistry content [17]. Context based chemistry learning can actually facilitate students in linking experiences, increasing learning motivations and scientific attitudes,also training student collaboration in solving the [18-20]. The analysis of pre-service chemistry teachers' ability related to the constructing of chemistry CoRe in this broader context needs to be assessed as an early indication of teacher readiness in carrying out quality chemistry learning.

Electrochemistry is classified as hard material in chemistry subject matter for high school students. Previous study [21] reviewed a number of articles then summarized some of the main alternative conceptions faced in electrochemistry as follow: (1) the cathode is a negative electrode, the oxidation reaction of half cells releases electrons, and reduces mass over time, (2) the anode is a positive electrode, the reduction reaction of half the cell accepts the electron and increases the mass over time, (3) the salt bridge allows electrons to move from the anode to the cathode, supplies the ions needed to move from the cathode to the anode, allows the cation to migrate towards anode electrode, while the anions migrate towards the cathode electrode, and (4) lack of ability to report cell reactions correctly. The teacher should plan learning well to help students understand electrochemistry topic. Developing CoRe is one way to develop the ability of pre-service teachers in designing proper electrochemistry learning. Therefore, this study aims to examine the ability of pre-service chemistry teachers in constructing Context-based Content Representation on Electrochemistry topic (Cb-CoRe-E).

2.2. Methods

2.3. Research design and samples

This study adopted descriptive research with quantitative approach. A total of 20 pre-service chemistry teachers involved in the Curriculum Review of Chemistry Education Course in Chemistry Education Study Program, Yogyakarta State University became the subject of this research. The samples were selected by convenience sampling.

2.4. Data collection technique and instrument

Data on the ability of pre-service chemistry teachers in constructing Cb-CoRe-E was measured through questions in pedagogical aspects [12]. The questions in the pedagogical aspects used in this study were based on the context used as the starting point in chemistry learning. The starting point of learning is one of the characteristic of context based learning [12, 22]. A total of 9 indicators were used to arrange the questions in pedagogical aspects to measure the constructing CoRe ability of pre-service chemistry teachers. The 9 indicators can be seen in Table 1.Beside the data on the ability of pre-service chemistry teachers in constructing Cb-CoRe-E, data from ideas or notions related to chemistry content formulated by pre-service chemistry teachers was also obtained.

Table 1. The Indicator of ability in constructing Cb-CoRe-E

No	Indicator
1	Determining the context used to initiate learning process
2	Knowing what pre-service chemistry teachers want students to learn from the developed ideas
3	Analyzing the importance of learning the developed content
4	Knowing what ideas/ content that the pre-service chemistry teacher knows but not the time yet for students to know
5	Knowing the difficulties or limitations related with the method on teaching the developed content
6	Knowing students' thoughts that might influence the pre-service chemistry teachers in constructing on the developedcontent
7	Knowing other factors that might influence the way of pre-service chemistry teachers construct on the content that has been developed
8	Knowing the teaching procedure and the specific reasons to apply it
9	Knowing whether to specifically ensure students' understanding or confusing related with the developed content

2.5. Data Analysis

The data obtained in this study were the ability of pre-service chemistry teachers in constructing Cb-CoRe-E then analyzed using quantitative descriptive techniques. There were 9 indicators that used as benchmarks in measuring the ability of pre-service chemistry teachers in constructing CoRe. Each indicator was given 0 to 5 score. The scores that obtained by pre-service chemistry teachers on each CoRe indicators then counted to obtain the mean value. The average score of each pre-service chemistry teacher in answering 9 CoRe indicators was also counted. The average ability of pre-service chemistry teachers in constructing Cb-CoRe-E based on predetermined indicators and the average of overall chemistry teachers ability in each indicator then classified into 5 categories ranging from very good to bad categories based on Sturgess formula. The average ability of pre-service chemistry teachers in each indicator are: having a bad category if the mean score is between the range 0.00 - 1.00; a poor category if 1.01 - 2.00; a sufficient category if 2.01 - 3.00; a good category if 3.01 - 4.00; and a very good category if 4.01 - 5.00.

2.6. Result and Discussion

The results of the analysis of the Cb-CoRe-E document showed that the mean score of the ability of the pre-service chemistry teacher in constructing Cb-CoRe-E was 3.4 and in the good category. The highest score achieved was 4.6 with very good categories, while the lowest score was 1.7 with poor categories. The ability of most pre-service chemistry teachers in constructing Cb-CoRe-E was included in the good category (35%). Figure 1 showed the distribution of teacher candidates' ability categories. One thing that needs to be considered is that there is still one prospective teacher who has the poor ability in constructing Cb-CoRe-E documents.

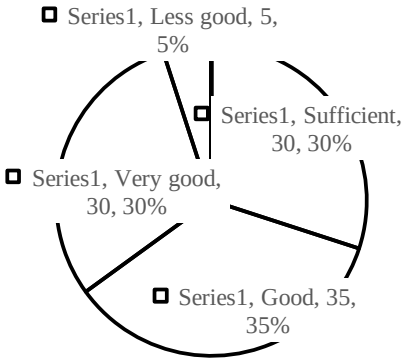

Figure 1. Distribution of categories of the ability of pre-service chemistry teachers in constructing Cb-CoRe-E

The result showed that the ability of pre-service chemistry teachers in constructing Cb-CoRe-E was good. Eventhough, there were some things that still need to be improved. For a deeper understanding, the ability of prospective chemistry teachers is analyzed based on nine questions in preparing Cb-CoRe-E.

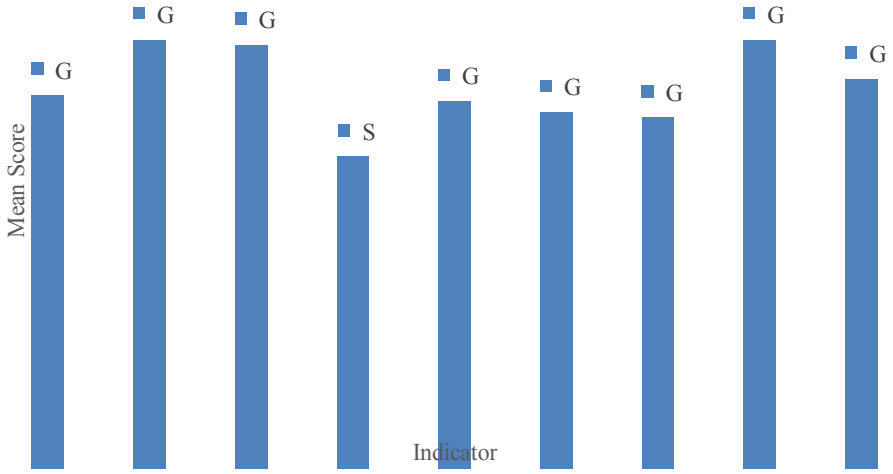

Figure 2. Mean score of pre-service chemistry teachers' ability for each indicator

Figure 2 showed that, of the nine Cb-CoRe-E constructing indicators, eight (Indicators 1-3 and 5-9) are achieved in good categories and others in sufficient categories (Indicator 4). One of the skills that should be improved is the pre-service chemistry teacher who knows about the content that they know but is not the time yet for students to know. Pre-service chemistry teachers have not fully mastered the concepts related to electrochemistry in depth so that it is difficult to describe their knowledge. On the other hand, there are limitations to prospective teachers in translating chemical concepts that students must know based on the formulation of competencies in the curriculum. This knowledge includes basic knowledge and core knowledge of electrochemical topics. As for the eight indicators that have been achieved in the good category, there are two that still need to be improved harder. First, indicator 7 related to the knowledge about other ways in influencing the way in teaching the topics.

Pre-service chemistry teachers need to be trained in explaining in detail the obstacles encountered when teaching content for each topic, not globally only stating because of limited facilities and infrastructure. Thus the pre-service chemistry teacher in determining the best learning according to the characteristics of each concept and conditions that exist. One other indicator (6) is related to the thoughts that students have and will influence pre-service chemistry teachers in teaching-related topics. Alternative knowledge possessed by students, for example about the anode which is considered always a positive pole becomes the basis of prospective teachers to find the best strategy. Otherwise, Cb-CoRe-E development help pre-service chemistry teachers to be better in preparing of chemistry learning. Through Cb-CoRe-E, pre-service chemistry teachers study chemistry content critically so they understand chemistry content deeply. The ability of pre-service teachers in constructingCb-CoRe-E is very important to be reviewed as the teacher's effort to prepare meaningful chemistry learning.

The overall ability of prospective teachers is also influenced by the ability to identify subtopics that must be taught in electrochemical content. Based on curriculum analysis, there are eight subtopics that should be taught including equalizing redox reactions, potential of reduction, voltaic cell, application of voltaic cell, corrosion, electrolysis, Faraday' Laws, and Application of electrolysis cell. However, the results of the study indicate that not all prospective teachers can bring up subtopics (see Figure 3).

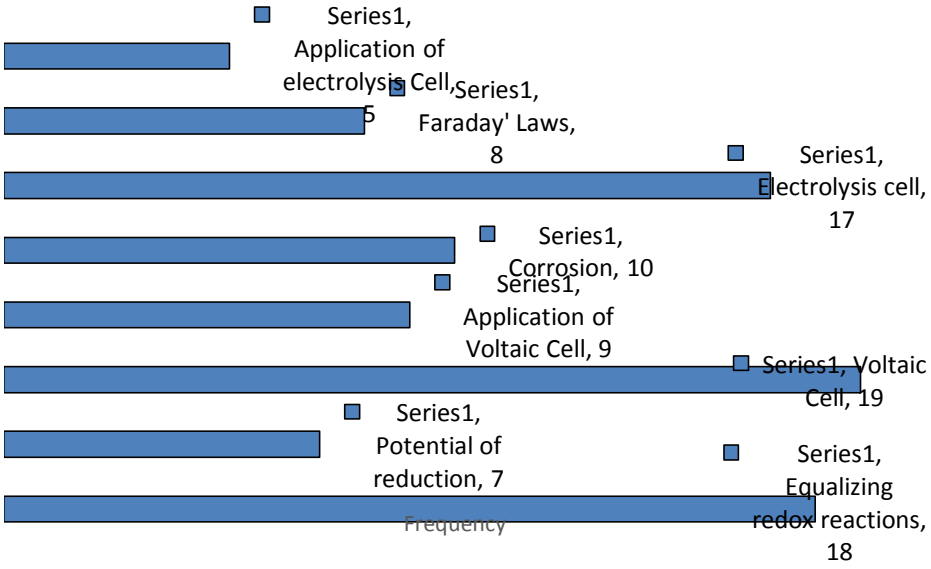

Figure 3. Frequency of appearance of subtopics in Cb-CoRe-E

Among the eight subtopics, only one subtopic is the voltaic cell that is raised by almost all prospective chemistry teachers. One prospective teacher who does not bring up this subtopic immediately displays it in the application subtopic. Most of the pre-service chemistry teachers have not separated the importance of separating the study of basic concepts and applications for both voltaic and electrolysis cells. This is very important so that pre-service teachers can provide a more thorough explanation, especially in relating context. Thus in teaching teachers not only gives an example of the use of concepts in general but trains students to overcome the problems of daily life related to the use of concepts.

In other hand, relating to integrate context, most of students can give simple example whether the daily process that can be used as context in electrochemistry learning. They propose to use some cases such as photosynthesis, painting fence of house, coating of vehicle component, gold bracelet, battery, and accumulator. Even though, pre-service chemistry teachers have not depict the case clearly why these cases can be used as starting point in learning. It is should be improved since this is the emphasis in context-based learning so as to facilitate the development of high-level thinking skills for students. These results show the importance of equipping pre-service chemistry teachers on how to analyze curriculum and mastery of chemistry content and integrate it with the context properly. The results of this study are in line with the research [23] which states that the ability of pre-service

chemistry teachers to discuss electrochemistry uses in daily life is an important basis for the success of developing good CoRe. The development of Cb-CoRe-E is one way to train the ability of pre-service teachers to prepare meaningful and quality chemistry learning.

2.7.Conclusion

The ability of pre-service chemistry teachers in constructing Cb-CoRe-E was good. It mean that pre-service chemistry teachers were have a good knowledge both of pedagogical and content. Even though, they should improve their understanding of enrichment chemistry content knowledge and skill in integrating context for the learning effectiveness. They ready to start for conduct qualified chemistry learning. In the future, pre-service chemistry teachers can apply Cb-CoRe in each chemistry topic in order to hold meaningful learning for students.

2.8. References

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