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Enhancing the character of students' responsibility through context-based chemistry learning in vocational high school

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ABSTRACT: Enhancement of students' character has become a significant topic in chemistry education today. Responsibility is one of the important pillars of character. Chemistry learning that provides a variety of learning experiences with the optimization of student involvement facilitates the development of the character of student responsibilities. Descriptive studies have been conducted to explore the character of students' responsibility through the implementation of context-based chemistry learning. The samples of this research are students in an automotive program of vocational education. The results showed that the character of students' responsibility developed during electrochemical and petroleum subject matters. The analysis showed that most students already have a good character of responsibility. There are four indicators including response, earnestness, acceptance and execution. The character indicator with the best response was that of acceptance of responsibility. The poorest was the task execution indicator. The implementation of context-based learning opens the minds of vocational students that chemistry is important in supporting vocational competencies. This fosters responsibility for completing good chemistry learning tasks.

1 INTRODUCTION

Active learning pedagogies that facilitate students' engagement play an important role in the vocational education system. Competence based education, as a new orientation of vocational education, has led to fundamental changes in developing active learning. These changes include the scope of courses offered, the content, goals, forms of instruction and coaching roles (Bruijin & Leeman, 2011; Biemans et al., 2009). Meanwhile, context-based learning has become a current trend in chemistry education to further the interest of students in chemistry and to increase understanding of the concepts studied (Ilhan et al., 2016).

Context-based chemistry learning is developed with regards to phenomena, technical applications and their relevance to students' life/work, so that it is adequately applied in vocational learning. Hence, the emphasis of chemistry concept related to student expertise is required on chemistry learning For example, on learning about petroleum in automotive engineering programs. It will be better if the learning emphasized on the characteristics and using of fuels. The discussion of the other petroleum fractions does not need to be deepened. This is necessary because the wrong notion that chemistry is not relevant to the engineering discipline decreases interest and motivation of vocational students in chemistry learning (Madhuri et al., 2012). In addition to increasing interest in learning chemistry, context-based chemistry learning also supports self-regulation skills (Bruijin & Leeman, 2011). Students' responsibility can then be better developed. It increase attitude and achievement students also (Rahdiyanta et al., 2017).

Enhancing students' character has also become a significant topic in chemistry education today. Responsibility is one of the important pillars of character (Lickona, 1999). The value of responsibility is needed to develop a healthy soul, concern for interpersonal relationships and social life. Teachers are required to provide education to ethically build students' characters and can position themselves as responsible sections of society. Context-based learning is the suggested learning approach to developing students' responsibility (Chowdhury, 2016a). There, students can handle various moral and ethical issues in society, take responsibility and build good character.

In previous studies, it was not identified that context-based learning was emphasized to enhance students' responsibility. Thus, it is important that chemistry teachers in vocational high schools enhance students' responsibility through context-based chemistry learning.

2 LITERATURE REVIEW

Context-based approaches are approaches adopted in chemistry learning where the integration of contexts and applications of chemistry are used as the starting point for the development of scientific ideas (Bennett et al., 2007; Ilhan et al., 2016). In vocational learning, context covers a mixture of aspects and includes the nature of the vocational subject, the learning setting, specification of students' qualifications and students' learning styles (Faraday et al., 2011). An important element of a context-based learning environment is active learning (Parchmann et al., 2006). In this learning, students are required to have a sense of ownership of the subject and are responsible for their own learning.

In context-based learning, using contexts to increase students' need-to-know, creating everyday life situations and doing in-class activities play a great role in the learning process (Ültay & Çalık, 2012). Previous studies have shown that context-based chemistry learning facilitates students to make connections with their own experiences, giving students personal responsibility for their learning, improving their motivation, contributing to attitude development and having students tackle problems together (Bennett et al., 2005; Vos et al., 2010; İlhan et al., 2015, 2016). From another perspective, context-based learning enhances students' responsibility and builds good character (Chowdhury, 2016a). Thus, it is important that educators emphasize character education to develop scientific attitudes, personality and leadership of students through context-based chemistry learning. In this study, the context is the integration of chemistry content with the content of vocational subjects.

Character education is essential for building a moral society, and it is the conscious effort to cultivate virtue. The psychological components of character education encompass the cognitive, affective and behavioral aspects of morality such as moral knowing, moral feeling and moral action (Lickona, 1999). Anderson (2000) stated that character is defined as moral excellence and firmness, while integrity refers to a firm adherence to a code of moral values.

Good character consists of the values that represent good human qualities such as wisdom, honesty, kindness, self discipline, responsibility, self-reliance, perseverance, leadership, tolerance, happiness and respect (Lickona, 1999; Weber & Ruch, 2012; Shoshani & Slone, 2013; Sanderse, 2013; Walker et al., 2015; Chowdhury, 2016a). Lickona (1991) stated that two main moral values are respect and responsibility. It is further said that responsibility is the ability to respond or answer. Reigosa and Aleixander (2007) states that the one form of students' responsibilities are to carry out the tasks in their learning. Students with high responsibilities characters will try to complete the task well. Responsibilities are oriented toward others, giving attention and emphasizing the positive obligation to protect one another.

Teaching strategies involving students in group work and discussions on current issues, project assessments, group work evaluations, observation techniques, interviews, pretest, posttest, anecdotal records and audio- visual evaluations are suggested in learning that promotes students' character (Chowdhury, 2016b). According to the results of previous research, it is stated that implementation of character learning indicates a potential improvement in academic achievement and an array of positive behaviors (Park & Peterson, 2006; Weber & Ruch, 2012; Snyder et al., 2012). Chemistry learning that facilitates the development of student responsibility characters will ultimately have a positive impact on improving the quality of learning.

3 RESEARCH METHOD

A descriptive research design was used in this study to describe the development of character responsibilities of vocational high school students. The samples were 62 students in a vocational education automotive program in Indonesia, namely SMK N 2 Yogyakarta. The samples were determined using a cluster sampling technique. All students were male. There were two classes, one class of students of XI grade learning electrochemistry and the other one students of X grade learning petroleum.

Context-based chemistry learning was implemented in three meetings for each electrochemistry and petroleum subject matter. Students learned in small groups of 4–5 people. Chemistry learning for each meeting was conducted in four stages according to a science, technology and society approach. The learning stages were initiation, concept formation, understanding of concept and consolidation of concept. In the initiation stage, students analyzed problems of electrochemistry and petroleum in the automotive field. For example, students analyzed the differences in petroleum products in Indonesia from a chemistry perspective. Then, they identified alternative solutions to solve the problems from various learning resources

Data collection was conducted using a responsibility observation sheet. There were four indicators measured including response, earnestness, acceptance and execution (Lickona, 1999; Reigosa & Aleixandre, 2007; Weber & Ruch, 2012; Shoshani & Slone, 2013). The instrument was judged by chemistry learning experts to ensure its accuracy. Data collection was conducted during the learning process.

Descriptive analysis was used to determine the category of students' responsibility character. Students' responsibility character consists of five criteria, namely, very good, good, enough, poor and very poor.

4 RESULTS

4.1 *Students' responsibility character in each meeting*

The first result of the study is the pattern of character development of students' responsibilities from first, second and third meetings. Based on Figure 1, the score of students' responsibility tends to increase both in electrochemistry and petroleum learning.

The content of chemistry learning in this study was adapted to the automotive vocational context. In the petroleum subject matter, the first meeting discussed petroleum fractionation and the second meeting discussed gasoline and diesel fuel. In the last meeting, the students did the practicum to determine the condensed numbers of lubricants. The score of students' responsibility in the petroleum subject matter increased from 3.07 to 3.23.

The first material in the electrochemical class was the voltaic cell, then the second meeting discussed corrosion. In the third meeting, students carried out the electroplating practicum. All material provided was adapted to the automotive vocational context. The results of the analysis showed that the character of students' responsibility increased from meeting 1, 2 and 3.

4.2 *Category of students' responsibility character*

This section describes the results of character analysis of responsibilities at the end of context-based chemistry learning implementation. The result showed that the category of

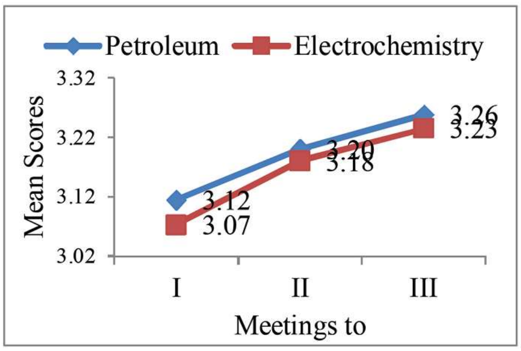

Figure 1. Trend of students' responsibility.

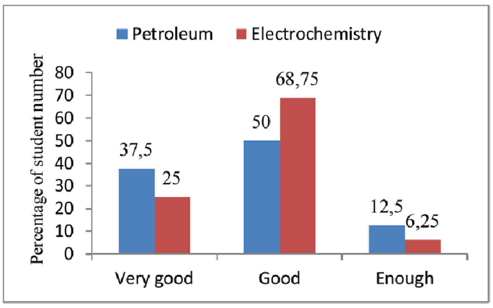

Figure 2. Distribution of students' responsibility.

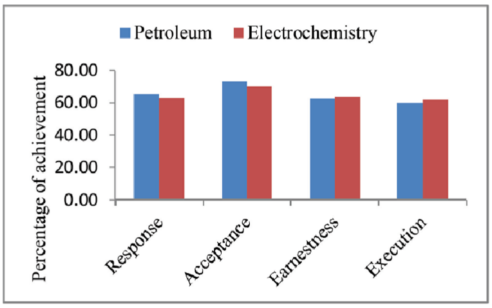

Figure 3. Profile of students' responsibility in each indicator.

students' responsibilities in learning of electrochemistry and petroleum are good. The mean score of responsibility in petroleum learning (13,03) is better than in electrochemistry learning (12,93).

According to Figure 2, the distribution of students' responsibility categories can be known. In the class with petroleum learning, half of the students have good responsibility character, 37,5% of students have very good responsibility character and the others (12,5%) in enough category. There are slight differences in the electrochemical class. The largest percentage remained in the good category but with a larger number (68.75%). The percentage of students in the very good category was 25% and the students with responsibility character in the enough category was relatively small (6.25%).

4.3 *Description of students' responsibility character in each indicator*

Furthermore, each indicator in the responsibility character that observed was analyzed to find out more about which character has developed well or not. The result of data analysis for the indicator of responsibility is based on the percentage of scores obtained compared with the ideal score. Based on Figure 3, it can be concluded that there is no indicator of responsibility character that achieves a percentage of achievement of more than 75% compared to the ideal score. This means that the character of responsibility in petroleum and electrochemical learning is still in the development stage.

The first indicator is response. The percentage of ideality of student character achievement is 65.2% for petroleum learning and 63.2% for electrochemistry learning. The second indicator is the acceptance character with 73% idealization for petroleum learning and 70% for electrochemistry learning. This achievement is the highest compared to other indicators of responsibility. Meanwhile, for the third indicator (earnestness), the percentage of ideal achieved for petroleum and electrochemistry learning is 62.6% and 63.8%, respectively. The last indicator with the lowest percentage of ideality is execution. The percentage of ideality is 60% for petroleum learning and 61.8% for electrochemistry learning.

5 DISCUSSION

The research findings showed that the implementation of context-based chemistry learning in petroleum and electrochemistry classes is able to develop the character of automotive vocational students' responsibilities. The four character indicators developed during the learning stage took place with each characteristic. The first stage of learning was the initiation. The students analyzed cases related to the automotive field and compiled questions based on the results of the analysis. Students worked in groups so that the response character would appear when students were enthusiastic to hasten interaction with the team to complete the task. The acceptance character was particularly visible from the students' cheer while discussing the stage of concept understanding and concept formation. Character of earnestness especially arose when students presented the results of group work at the stage of concept formation. Likewise when they complete the tasks at the stage of consolidation concept. The execution character was shown by the performance of the students which developed in all the learning stages. The results of previous research strengthened this finding that the application of context-based chemistry learning opens the perspective of students to see the benefits of studying chemistry related to life and work fields. It has a positive impact on the development of student character including responsibility and perseverance (Snyder et al., 2012; Weber & Ruch, 2012; Chowdhury, 2013).

The character of student responsibility at the end of petroleum learning is better than in electrochemistry learning. This can be understood from the standpoint of chemistry content characteristics. Petroleum material has a closer relevance to the automotive field especially in studying fuel systems. Conceptually, the electrochemical content is slightly more complicated and abstract than the petroleum content. Chemistry involves different terminologies, structures and calculations. The learning of these elements, for many students, may cause different levels of difficulties, so chemistry is too broad for them to learn in a short time.

Two characters that developed better were response and acceptance. Students of automotive vocational schools have a good response to the chemistry learning developed in accordance with their vocational context. This good response was shown by the students who, as soon as possible, involved themselves in learning. This attitude is closely related to student interest because the chemistry content taught is relevant to the needs.

Recent studies have shown that the transfer of chemistry to the engineering education context and its material retention is facilitated when the concept is presented in a familiar and related context (Huettel et al., 2013). A context for the chemistry learning in this study is developed with regard to phenomena that are relevant to students' field competence. This is in line with a previous study about implementation of the contextual learning approach in engineering education to increase students' attitudes by strengthening their motivation and interest, and thus promoting meaningful learning (Kukliansky & Rozenes, 2015). Because the students have a good interest, the character of acceptance develops more. This was indicated when students did the task happily.

The character of earnestness will emerge and develop after being embedded with the feeling of being happy with something. This is the case with automotive vocational students in context-based petroleum and electrochemistry learning. With a high interest, students are moved to be serious in carrying out what is assigned. Earnestness is one form of responsibility character. The character of sincerity is also motivated by the knowledge that what is learned is needed in developing the competence of skills. Chemical learning on previous occasions that emphasized theoretical aspects was less attractive to vocational students. Automotive vocational students can see the relevance between petroleum and electrochemistry learning with their expertise in context-based learning.

6 CONCLUSION

Implementation of context-based chemistry learning in petroleum and electrochemistry provides student involvement and facilitates the development of the character of student responsibilities. Most students already have a good responsibility character. Among the four indicators of responsibilities, acceptance has the highest score. The lowest is the indicator of task execution. The implementation of context-based learning fosters responsibility for completing good chemistry learning tasks.

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