Implementing Chemo-entrepreneurship-based inquiry learning on the acid-base concept to increase science process skills and students’ interest in entrepreneurship

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Abstract. This study aimed to determine the use of CEP-based inquiry learning that influence the increase in SPS and students’ interest in entrepreneurship in the concept of acid-base. The research method used was pre-experimental design with research design with one group pre-test post-test design. The study population was students of class XI MAN Banda Aceh which consisted of three schools. Determination of the sample was carried out by purposive sampling technique, the measurement carried out using entrepreneur interest questionnaires. Whereas class determination was done by total sampling technique. The results showed that the initial analysis of the student’s SPS was 33.88 after the CEP-based inquiry learning was applied must be there an increase of 88.71 with 84.04 N-gain acquisition which included high criteria. This proves that CEP-based inquiry learning is effective in increasing student’s SPS in the concept of acid-base. The interest of entrepreneur students gained an average of 76.37.

1. Introduction
Acid-base is one of the chemical materials taught in even semester XI. The concept of acid-base tends to be abstract if learning is taught using lecture method so that students tend to be bored in taking part in the ongoing learning process. Moreover the interest of students in chemistry lessons in MAN is still relatively low. Therefore, innovation in chemistry learning is needed, especially in acid-base material. One of the changes that can be applied is by integrating the concept of acid-base in Craft learning & Entrepreneurship, considering that acid-base is very much found in the surrounding environment which can be processed into an entrepreneur-oriented product [1].

Education of entrepreneurship has grown rapidly in the world of education, it aims to improve skills, knowledge and attitudes, and to create jobs that contribute to economic growth and development [2]. Entrepreneurship can be taught through appropriate learning methods or models, such as using inquiry learning. Several studies explained that inquiry use was more effectively applied than conventional [3], because this learning taught students to make judgments and create their own jobs. Entrepreneurship learning is a process of finding, evaluating or creating opportunities through planting innovations or
integrating new values, products or services, and training students to be able to enhance high level of creativity [4]. Thus, high-level learning can be taken into consideration in entrepreneurial practice [5].

Chem-o-Entrepreneurship (CEP) is one of the learning approaches developed to link material that is being studied with real phenomena that exist around life [6]. So that the approach is not only educational, but also allows students to be able to learn a processing process from a material that is useful, has economic value, and can motivate entrepreneurship. According to Prahastuti, et al. [7] Learning through the CEP approach can effectively improve science process skills (SPS), foster a spirit of entrepreneurship, so that the students’ can experience changes in learning outcomes in a better and more beneficial direction. SPS is the ability possessed by students to apply scientific methods to understand, develop and discover science. SPS is classified as one of the frequently used thinking skills [8], because these skills are not only used in education process but also can be used in everyday life [9].

Nurmasari, et al. [10] revealed that learning chemistry by applying the CEP can create a more enjoyable learning environment and can activate students, also provide opportunities for students to develop their life skills. In addition, the implementation of enquir in science learning is also very effective in supporting the understanding of student’s scientific concepts [11]. Murphy, et al. [12] proposed that learning by applying inquiry can support the development of student’s scientific knowledge and skills, and can influence the increase in interest and motivation in science learning, and train students to think critically in solving problems.

A study conducted by Nurmasari, et al. [10] also showed that the application of the CEP-oriented approach proved effective and significant to be applied to understanding the concepts and life skills of students. Where the average concept understanding in the experimental class was better than the control class which were 80.11 and 74.32. And the student’s life skills increased from 61% to 84%. Research had also been conducted by Prahastuti, et al. [7] which proved that the CEP learning device can increase creativity and SPS of students. Where SPS was belonged to the good category with an average acquisition of 92, while the creativity of students was also in a good category with an average acquisition of 80.15.

Research was also conducted by Adlim et al. [13], who said that the high number of creativity can produce a product if using the syntax in SPS. In the study of Syukri et al. [14]; Nejla and Ziya [15] showed that the incorporation of SPS and entrepreneurship can produce an innovative product or idea. By applying CEP by experimenting, it can increase student’s interest in entrepreneurship and have an entrepreneur's attitude or behavior [16]. In addition to CEP, the inquiry learning can also increase SPS, as research conducted by Rahmasiwi et al. [17] showed that in the first cycle the average value was 49.14%, the second cycle was 62.05%, and the third cycle was 76.45%.

2. Methods
This study used a pre-experimental design method with the design of one group pretest-posttest design. The population in this study was three high schools in Banda Aceh. The sampling technique in this study was Purposive Sampling, a measurement carried out using entrepreneur interest questionnaires. Schools that have low interest in entrepreneurship were used as samples. The class determination was done by total sampling technique. Student's SPS increase was obtained from pretest and posttest data. While the interest of entrepreneurship was obtained from questionnaire data of entrepreneurship interest in students before and after the chemo-entrepreneurship (CEP) inquiry learning was applied.

The process before conducting the research begins with the development of instruments worksheet, all instruments were validated to each expert. Questions are given to the validators in order to give an opinion on the content and suitability of the question with the concept of acid-base. After the questions were validated, followed by reliability testing, the level of difficulty of the questions, and the power difference. The questions developed can measure student SPS. They are given in the form of descriptions of 10 questions made based on aspects of SPS measurement.

The next instrument was worksheet according to the CEP based inquiry learning. The validation phase was carried out to determine the content, and the material was in accordance with the learning
model, while for the questionnaire of students’ interest in the entrepreneurship was validated to determine the suitability of entrepreneurship indicators with the criteria tested.

The analysis technique for increasing the SPS of students before and after learning was calculated based on the $N_{gain}$ score developed by Meltzer [18]. While students’ interest questionnaires are calculated using the formula proposed by Sudijono [11].

3. Results and discussion
3.1 Student science process skills
Student’s SPS results are seen from the SPS indicator values on each question, as for the questions given in the form of descriptions. An analysis of the increase in SPS of students can be seen from the acquisition of the average $N_{gain}$ value for each SPS indicator. This value was obtained from 10 questions in 1 question containing 1 SPS indicator. The item analysis of the indicator aimed to see the ability of students in the scientific process. It was expected that students would be able to master the indicators of SPS after the learning process had been carried out by applying the CEP-based inquiry learning to the concept of acid-base. According to Peffer and Ramezani [19] science learning is better taught by directly involving students in practice, such as arguments or conducting investigations. The inquiry is a learning model that can be applied in science learning to produce new knowledge for students through science practice.

The SPS indicators analyzed in this study were interpreting, predicting, applying concepts, grouping, communicating, asking questions, hypothesizing, observing, and planning experiments. The acquisition of the average ability of students in completing increases on each SPS indicator while in the posttest. The description of the difference in increment can be seen in Table 1.

| Aspects of SPS       | Pretest | Posttest | N-gain |
|----------------------|---------|----------|--------|
| Hypothesize          | 26.78   | 86.89    | 85.90  |
| Planning an experiment| 28.42   | 95.63    | 94.26  |
| Grouping             | 25.14   | 77.60    | 66.67  |
| Observation          | 18.03   | 81.97    | 77.05  |
| Interpreting         | 43.17   | 93.99    | 89.07  |
| Forecast             | 44.41   | 83.61    | 69.67  |
| Applying the concept | 43.17   | 95.63    | 93.72  |
| Communicate          | 36.61   | 87.43    | 85.52  |
| Asking question      | 38.80   | 95.63    | 94.54  |

Based on Table 1, the average posttest percentage value for each SPS indicator increased after the CEP-based inquiry learning had been applied and filled the worksheet well for the acid-base concept. In order to better understand the causes of an increase in SPS, the following will be explained one by one. The first aspect seen in measuring SPS is hypothesizing, in this skill the ability of learners is classified as good, where it could be seen from the average pretest score of 26.78 and posttest 86.89 with $N_{gain}$ value of 85.90 which was included in the high criteria.

In measuring the second SPS is designing experiments, in this aspect students are required to be able to know the tools and materials in accordance with the experiment and can design work procedures to conduct experiments. The average results obtained from this aspect for the pretest stage was 28.42 while in the posttest stage was 95.63. The $N_{gain}$ value was 94.26 which was in the high category. This could be seen when students get assignments in the second meeting of the worksheet, where students
were very active in finding references to work procedures for the experiments that would be conducted with group members.

Grouping is the third skill of SPS, where students are expected to be able to explain the differences in the theory of acids and bases that have been presented by experts. In this aspect, it was seen that the achievement of students belonged to the medium category, that was because many students still find it difficult to distinguish or explain the advantages and disadvantages of the theory of acids and bases from experts. The results obtained showed that at the pretest stage students get a value of 25.14 while the posttest stage increased with the achievement of an average value of 77.60 with N-gain of 66.67.

The aspect of the fourth SPS skill is observation, in order to see the extent to whether students know the substances contained in a sample. In this skill for the pretest stage students got a value of 18.03 while in the posttest stage the score increased with an average value of 81.97 while the N-gain obtained was 77.05 which was in the high category. So that it can be concluded that the achievement of students in observation skills is classified as good.

Skill from the fifth aspect is interpreting. The indicators used in this aspect know whether a solution contained acid or base ions. In this skill, the students obtained a pretest score of 43.17 while in the posttest stage they got 93.99 with the achievement of N-gain 89.07 which was in the high category.

The sixth aspect is forecasting which showed the percentage of pretest results of 44.81 while posttest was 83.61 with N-gain of 69.67 which is classified as medium criteria. This was because there were some students who were still mistaken in comparing color changes to litmus paper so that they were not appropriate in predicting the pH of the sample.

Furthermore, the seventh skill from the SPS aspect is to apply the concept that got the percentage of pretest of 43.17 as well as posttest of 95.63 with an N-gain value of 93.72 which is of high criteria. In this skill students were able to understand and explain the concept of acid-base.

The eighth skill of SPS is the communicating aspect, with an average pretest gained of 36.61 while the posttest stage got 87.43 with an N-gain value of 85.52 which is in the high category. In this skill, students were able to explain the relationship of the strength of acids or bases to acidic and basic constants. Besides that, it could also be seen from how they present the results of their group work well, structured and correct, and able to explain using good and polite language.

And the last is the skill of asking questions that obtained a mean pretest of 38.80 while the posttest stage was 95.63 with an N-gain value of 94.54 which is of high criteria. The indicators used in this aspect were connecting the strength of acids and bases based on pH with the same concentration. In addition, it could also be seen from the active participation of students in asking questions in each group that presented.

From the explanation above, it can be concluded that learning by applying the CEP-based inquiry learning can increase student’s SPS, with an average N-gain value of 0.84 which is included in the high category. This was because the inquiry learning method had a very significant effect in increasing student SPS compared to using conventional methods [20]. Similar research had also been conducted by Ayunintyas, et al. [21] which revealed that SPS learners could be taught by using training inquiry learning better than students who were taught by conventional models where the SPS got an average value of 83.31 which is categorized as good. Saidaturrahmi, et al. [22] also proved that inquiry-based learning can increase student’s SPS, where it could be seen from the results of the study that the student's average SPS score reached 86.00 which is categorized as very good.

Based on the description of the explanation above, it can be concluded that the CEP based inquiry learning is able to increase SPS towards students. Because inquiry-based learning is a form of active teaching that is centered on students, which helps students develop critical thinking through problem solving [23]. This can be seen from the acquisition of the average N-gain value, which was 84.04, which belongs to the high category.

3.2 Student interest in entrepreneur
The interest of students in entrepreneurship is still very lacking, this could be seen from the questionnaire interest data obtained before conducting research. The questionnaire used had been validated by experts.
The results of the student interest in entrepreneurship can be seen in Figure 1. The measurement of interest was calculated based on the average score obtained by the overall scores of students, then tabulated in percentages and drew conclusions based on the categories with a predetermined formula.

![Student Interest in Entrepreneur](Image)

**Figure 1.** The results of the analysis of the interest indicators of students’ interest in entrepreneurship before and after the CEP-based inquiry learning were applied.

Based on the analysis of interest indicator data in Figure 1 it can be seen that the percentage of entrepreneur interest as a whole before and after learning had increased. The description of the achievement of each indicator is as follows.

The first indicator is the willingness to achieve goals and necessities of life, obtaining the mean before and after learning, respectively 40.78 and 85.66 with high categories. Through worksheet students were assigned to complete one experiment with their group members and the results must be reported at the set time, so that at this stage students were trained to be able to have a strong will in achieving goals that had been designed with group members and teachers. Hard will as well as motivation which meant encouragement or effort to achieve goals. With the encouragement of the teacher in achieving this goal would trigger the students to act and do something because of the purpose, drive and needs [24].

Strong belief in the strength of self is the second indicator of interest in entrepreneurship, that obtained a mean value before and after learning of 0.44 and 88.93 which are high criteria. At this stage students were required to be able to plan carefully and have strong confidence in themselves to be able to carry out experiments that had been designed with group members. In this arrangement, students were guided by the teacher, but they were free to determine the products they wanted to make according to their abilities and beliefs with members of the group that had been formed. By being given freedom in determining the products to be produced by each group, it was expected that students were able to develop quality and had strong confidence in the strength of themselves in creating a creative product. Ulfiatun et al. [24] said that one of the goals of education based on entrepreneurship is to be able to develop attitudes and self-qualities which include the ability and courage to take action according to one’s abilities.

Furthermore, honesty and responsibility are the third indicator of entrepreneurial interest, which increased after the learning process with mean of 87.09 which is included in the high criteria, compared to before doing the learning with a score of 51.23. Responsible attitude could be possessed by students when doing work to get satisfaction [24]. To fulfill this indicator, students were given assignments to be collected in the form of reports and documentation as good as possible. This could help students to behave honestly by reporting experimental results and obstacles faced in completing the experiment. As for completing group assignments there were obstacles, where the distance among homes between students was far apart because the tasks given the workmanship must be done outside the lesson hours, but most students have a high sense of responsibility towards the given task.
The fourth indicator is physical and mental endurance, could be seen from the efforts of students in completing the tasks given by the teacher. The average gained before and after applied learning was 34.15 to 84.29 which is classified as high criteria. Then the measurement of interest in entrepreneurship the fifth indicator was perseverance in work and effort, which obtained the percentage of values before and after learning, 36.48 and 81.56 which are classified as high categories. This was because learning was done using CEP-based worksheet which aimed to make products while marketing them. Thus it could stimulate students to have perseverance in completing tasks in order to achieve the desired target. Because introducing the world of entrepreneurship is the best solution to overcome the increasing number of unemployed educated circles [25].

Creative thinking and constructs are the sixth indicators which also belonged to the high category. To see this stage students were required to create innovative and creative products in order to have a sale value. As said by Ulfiatun, et al. [24] that learning with the CEP approach can make students more creative so that they can apply the knowledge they have learned in their daily lives. This indicator increased after the implementation of the CEP-based inquiry learning, from 36.07 to 82.79.

Oriented to the future is the seventh indicator of entrepreneurial interest, where the percentage before and after learning was 38.52 to 86.89 which is categorized as high. This was because in the learning process students were trained to think ahead of what kind of products would be created, how to make, and what strategies should be used for marketing. Students were required to use basic ingredients in the surrounding environment in the process of making products.

Finally, the indicators of interest in related entrepreneurs is taking risks. This ability was trained when students started trying to make experiments that had been designed with group members to produce a product that has economic value. The results obtained are included in the high criteria after the application of the learning model, which was 34.02 to 82.79.

Based on the explanation above, it can be concluded that the CEP based inquiry learning can increase entrepreneurial interest in students on the concept of acid-base. This can be seen from the average N-gain obtained that was 76.37 which is classified as high criteria. As for some of the results of research that supports them such as Katamsih, et al. [26] where the interest of entrepreneurship increases in the experimental class after the application of entrepreneurship-based learning models, with the acquisition of an average value before learning of 71 while after learning the value of 73 is classified as high criteria. Ismulyati and Ikhwani [27] also proved that the students’ interest in entrepreneurs can be increased by applying the CEP at the second cycle stage with the percentage of choices strongly agree from 20 to 47, for those who agreed showed the same percentage, namely 32, the choice disagrees showing the percentage of 32 to 15.2, and for very disagree, it decreased from 16 to 6.8.

The same study was also carried out by Sunarya et al. [28] where the interest of entrepreneurs also increased after the application of CEP oriented learning, it can be seen from the percentage of 26.32 with the number of 10 students who were in high criteria, and 28 other students having an interest with a percentage of 73.68 which was classified as very high. Sumarti [29] proved that learning by applying the CEP approach was able to increase the interest of entrepreneur students where the percentage of interest gained was 47.64 to 51.17.

Developing entrepreneurial interest in students is one alternative to reduce unemployment among educated people [30]. By implementing CEP in PKW learning, it is expected that students can gain knowledge about good business intricacies and able to take advantage of opportunities around them to create their own business after graduation or while still studying in college [31]. In addition, with the entrepreneurial spirit in students, they can change their mindsets to be innovative, creative, proactive, flexible, development-oriented and risks taker.

4. Conclusion
The results showed that the initial analysis of the SPS of students was 33.88 after the CEP-based inquiry learning was applied an increase of 88.71 with 84.04 N-gain acquisition which included high criteria. This proved that CEP-based inquiry learning is effective in increasing student’s SPS in the concept of acid-base. The students’ interest in entrepreneurship gained an average of 76.37 which is included in the
high category. Each indicator of interest experienced an increase because the students were enthusiastic in working on the worksheet and practising the product design that will be tried. So the CEP based inquiry learning can increase students’ interest in entrepreneurship.

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