Online or Offline? A Pedagogical Debate on the 5E Learning Cycle Model

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Abstract. Learning has been carried out flexibly, meaning that if the Covid-19 condition increases, the learning will be carried out online. If the Covid-19 conditions decrease, the learning will be carried out offline again. This study aims to determine the differences in conceptual understanding of students taught using the 5E learning cycle model offline and online on acid-base material and to describe students' conceptual understanding in offline and online learning. The research method used is true experimental using randomized Pretest-Posttest Control Group designs. The population in this study were students of the Chemistry Education study program at Tanjungpura University. The sample selection technique was carried out by saturated sampling. Data collection was done through measurement using a learning outcome test instrument. Data analysis techniques were carried out inferential statistics using SPSS applications and qualitative descriptive. The results obtained sig value. $0.49 > 0.05$, and the average N-Gain value was 0.58 for the experimental and 0.51 for the control classes. This study concludes that the conceptual understanding of students taught online and offline using the 5E learning cycle model with an average increase in concept understanding in both classes in the medium category is the same.

Keywords: Online · learning cycle 5E · pedagogical

1 Introduction

The current learning process tries to "make peace" with the conditions of the Covid-19 pandemic that has hit Indonesia for more than two years. Learning has been carried out flexibly, meaning that if Covid-19 conditions increase, learning will be carried out online, and if Covid-19 conditions decrease, learning will be done offline again. The learning process is the most significant impact of COVID-19 on the world of education [1]. Learning from offline to online and vice versa has forced various parties to follow the flow that can be taken so that learning can run adequately [2]. Educators and school elements try to transition changes in the learning system back offline to achieve educational goals [3].

The challenge of educators in carrying out such learning is even more complicated when there are complex and abstract concepts such as Chemistry in the field of science.

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Chemistry is a science that studies everything, such as the structure, composition, properties, and changes in matter and the energy that accompanies it [4]. Chemistry teaches knowledge in the form of facts, concepts, and principles and provides direct experience for students to understand the surrounding nature scientifically [5]. The concepts in chemistry are tiered from simple to higher level or more complex [6]. In addition, the concepts studied in chemistry are numerous and complex, abstract and interconnected [7].

Acid-Base material is a complex and abstract Chemistry material related to other chemical materials. Acid-Base material is very complex when viewed in terms of its characteristics [4] and is the basis for learning the concept of salt hydrolysis [7]. In addition, Acid-Base material is one of several Chemistry materials that students need help understanding (Izza et al., 2021; Zuhroti et al., 2018).

Students of the Chemistry Education study program at the Faculty of Teacher Training and Education, Tanjungpura University, also experience difficulties with Acid-Base material. These difficulties include 1) difficulty in identifying ionized and hydrolyzed species; 2) difficulty in determining pH according to conductivity; 3) difficulty in distinguishing strong and weak acids and bases; and 4) difficulty in determining the pH of the solution [9]. Not all students who follow the learning process can understand the chemical concepts they learn [5]. The concepts students build based on personal understanding have implications where they build an incomplete understanding of concepts [6].

Students need to understand concepts in Acid-Base material so that they can quickly master other materials, such as Salt Hydrolysis material. As much as 51.5% of understanding the concept of Acid-Base affects understanding the concept of Salt Hydrolysis [7]. Consistent misunderstanding of concepts by students will affect the following learning process [6]. A basic understanding of chemical concepts is fundamental because it helps in learning chemistry with various characteristics [8]. Good mastery of concepts will enable students to think higher [10].

Efforts to improve a complete understanding of concepts in acid-base material during the Covid-19 pandemic can be made through active learning centred on students offline and online. Students should be required to be more active in learning to get meaning in chemistry lessons [11]. During the Covid-19 pandemic, online and offline learning systems expect innovative education to educate students so that learning success can be achieved effectively [2].

The 5E Learning Cycle model is one of the learning models that can be applied in online and offline learning by involving the active role of students. This model more quickly encourages learners to continue learning scientific concepts so that they play an active role in acquiring knowledge and building concepts independently [11]. Learners must reduce and explore all their understanding and experiences related to the learning material being taught [12]. The stages of the Learning Cycle are the development of cognitive aspects whose learning objectives are to improve student understanding [13].

Some research results show the success of the 5E Learning Cycle model in improving students' conceptual understanding in offline learning (Sartika, 2018; Yulasti et al., 2018; Razak, 2018; Sartika & Hadi, 2021) as well as online learning (Sartika et al., 2021). Based on the explanation above, researchers are interested in conducting a study entitled The Effectiveness of Online and Offline Learning using the 5E Learning Cycle Model on Acid-Base Matter. The novelty of this research is that researchers will determine which online or offline learning is more effective in improving the conceptual understanding of Chemistry Education study program students at the Faculty of Teacher Training and Education, Tanjungpura University, by using the 5E Learning Cycle model on Acid-Base material.

This research is expected to provide information for education/other researchers on the effectiveness of the 5E Learning Cycle model in offline and online learning for acid-base material so that it can be an alternative model used in the classroom activating students. This study aims to determine whether there is a difference in concept understanding and describe the increased concept understanding of students taught using the 5E Learning Cycle model offline and online on Acid-Base material.

2 Method

2.1 Stage of Instrument Development

This research is true experimental designs with randomized Pretest-Posttest Control Group designs. The population in this study were students of the Chemistry Education study program at Tanjungpura University. The sample selection technique was carried out by saturated sampling, where population members were used as samples. The independent variable in this study is offline and online learning taught using the 5E learning cycle model on acid-base material. The dependent variable in this study is student concept understanding.

The data collection technique used is a measurement used to determine concept understanding. The research instrument used was a learning outcome test, with the following indicators: 1) explain the nature of acids or bases based on the theories of Arrhenius, Bronsted-Lowry, and Lewis; 2) determine the concentration of $[H^+]$ and $[OH^-]$ from a solution whose pH is known; 3) determine the pH of a robust base solution; 4) identify acidic or basic properties in sample solutions; 5) determine the vinegar content; 6) determine Ka; and 7) determine the pH of a weak acid solution.

The data analysis technique uses inferential statistical analysis with the SPSS application to determine differences in student concept understanding and qualitative descriptive analysis to determine the increase in student concept understanding with the normalized gain score formula (Hake, 1999) in [19]:

$$\% < g > \equiv \frac{\% < G >}{\% < G > max} = \frac{\% < Sf > - \% < Si >}{100 - \% < Si >} \quad (1)$$

Description: <g> = mean normalized gain; <G> = mean gain; <Sf> = class posttest mean; <Si> = class pretest mean. The classification of normalized gain is as follows: $g < 0.3$ (low); $0, 3 \leq g < 0.7$ (medium); and $g \geq 0.7$ (high) (Hake, 1999 in Nissen et al., 2018).

3 Results and Discussion

The description of student learning outcomes taught using the 5E learning cycle model online for the experimental class and offline for the control class can be seen in Fig. 1.

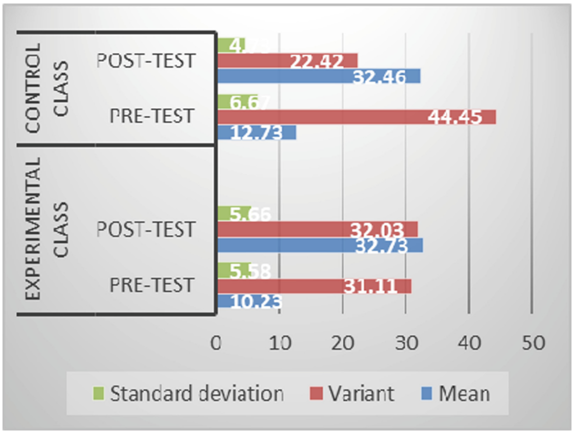

Fig. 1. Description of student learning outcomes.

Figure 1 shows that the average learning outcomes of students in the experimental class taught online and the control class taught offline are similar. This research instrument is an interest questionnaire consisting of independent variables, namely the practicum method with the help of simple practicum tools and students' interest in learning as the dependent variable. This learning interest questionnaire is given to 40 high school students consisting of 20 students in the control group and 20 in the experimental group. The experimental group was given treatment during the learning process using the practicum method, while the control group implemented the conventional method.

3.1 Differences in Understanding of Experimental and Control Class Students

The initial step to determine the difference in understanding of experimental and control class students is to test the normality of the initial test data using the Shapiro-Wilk test. The normality test results obtained a sig value. 0.373 for the experimental class and sig. 0.769 for the control class, where both are > 0.05 (H0 is accepted), meaning that the data of both classes are typically distributed. The independent samples t-test obtained sig determined students' initial concept understanding. $0.095 > 0.05$ (H0 accepted) means that the initial conceptual understanding of experimental and control class students is the same.

Furthermore, using the Shapiro-Wilk test, the normality test was carried out on the final test data. The test results obtained by the experimental class have a sig. $0.083 > 0.05$ (H0 accepted) means that the experimental class's final test data is usually distributed, while the control class has sig. $0.024 < 0.05$ (H0 rejected) means the control class final test data is not normally distributed. The Man Whitney U test obtained sig determines student conceptual understanding differences. $0.499 > 0.05$ (H0 accepted), meaning there is no difference in understanding the acid-base concept in students taught using the 5E cycle model online with offline.

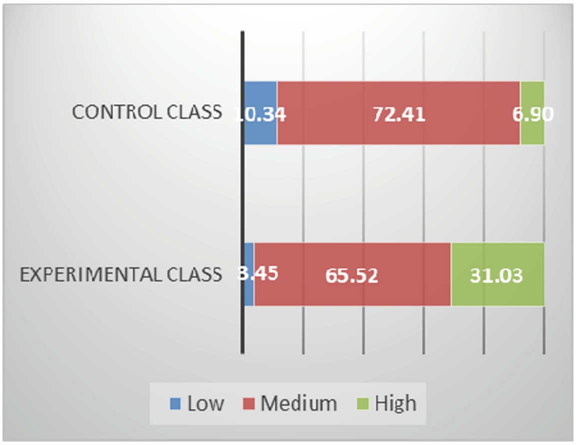

Fig. 2. Improvement of student conceptual understanding.

3.2 Improvement of Students' Concept Understanding in Experimental and Control Classes

The increase in concept understanding of experimental and control class students can be seen in Fig. 2.

Based on Fig. 2, the average increase in understanding of the concept of experimental and control class students is in the medium category.

Students' understanding of concepts increases due to using the 5E learning cycle model. This model starts from the engagement phase through providing apperception and motivation to students. In the engagement phase, educators arouse students' interest and curiosity about the material being studied by linking the learning material to everyday life so that it can help identify the problems faced [16]. Giving apperception is done by asking questions about the characteristics of acidic and basic compounds. Giving apperception in this phase is to discover students' initial knowledge and skills before learning the acid-base concept. Learners can remember material under positive stimuli provided by educators, which dramatically helps them understand the material provided [20]. Motivation is given to students by asking questions related to the pain felt by people with ulcers due to contact between stomach acid and injury or irritation to the stomach wall. The administration of antacids is to neutralize the highly acidic condition of the stomach so that the pain will disappear. High motivation will result in better concept mastery and vice versa [21].

The exploration phase is carried out by providing opportunities for students to discover the concept of acid-base independently with the help of student worksheets. Students in this phase are given the opportunity, independently or in groups, to make observations and collect and record data without direct teaching [22]. Students are asked to do a group practicum to determine the pH of several solutions and then match the pH of the solution obtained from the observation and calculation process. Students are given a practicum video in the worksheets, which contains practicum procedures and observation results, as well as worksheets for determining the pH of the solution. In contrast, in the control class, students carry out the practicum according to the work procedures in the worksheets. Learners discover and discuss knowledge with their friends to equalize their understanding through experiments [12]. Educators, as facilitators, guide students in finding or analyzing answers to the problems given [20].

The acid-base concept in this phase is constructed through empirical and theoretical studies. Empirical studies are carried out by observing the colour change of universal indicator paper and matching it with the colour of the normal pH available to determine pH. The pH value from the results of empirical studies is compared with the pH value based on theoretical calculations to strengthen students' conceptual understanding. During concept building, students will experience the process of assimilation and accommodation until they reach the equilibrium process of the concepts they learn. The success of learning can be seen from the increasing ability of students to learn independently.

The explanation phase provides an opportunity for students to present their group results. Learners build and re-express the concepts obtained with their language in the explanation phase [16]. This stage aims to complete the concepts that students have obtained through explanation and discussion [22]. Each group was asked to present the results of their observations and calculations of pH for each solution. All groups managed to determine the pH value correctly.

The following learning step is the elaboration and evaluation phase. The elaboration phase facilitates students to develop concepts obtained in the exploration phase through their application in new situations. Learners apply concepts and skills by strengthening and expanding concepts that have been learned [22]. Students are asked to determine the acetic acid content contained in the vinegar sample. Concept development in this phase is also carried out empirically and theoretically by comparing acetic acid levels from observations and calculations. The evaluation phase is carried out by giving a final test to students to obtain an overview of student conceptual understanding. This stage is students' understanding of the concepts learned [16].

4 Conclusion

This study concludes that the conceptual understanding of students taught online and offline using the 5E learning cycle model with an average increase in concept understanding in both classes in the medium category is the same. Suggestions in this study should be blended learning, especially in the exploration phase, to maximize students' conceptual understanding in online classes.

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