JTK: Jurnal Tadris Kimiya 7, 2 (December 2022): 245-257
Website: http://journal.uinsgd.ac.id/index.php/tadris-kimiya/index
ISSN 2527-9637 **(online) ISSN** 2527-6816 **(print)**

Implementation of 8E Learning Cycle Model with Instagram to Overcome Student Misconceptions in Buffer Solution Material

Muhammad Rizal[1], Rusmansyah[1*], and Rusliana Sari[2]
[1]Chemistry Education Department, Faculty of Teaching and Learning, Universitas Lambung Mangkurat, Jl. Brigdjen Hasan Basri, Banjarmasin, 70123, Indonesia
[2]SMA Negeri 2 Banjarmasin, Jl. Mulawarman, Banjarmasin, 70117, Indonesia
[*]E-mail: rusmansyah@ulm.ac.id

Received: 04 October 2022; Accepted: 29 December 2022; Published: 31 December 2022

Abstract

This study aims to determine the effectiveness of applying the 8E learning cycle model with Instagram to overcome student misconceptions in Buffer Solution material. In particular, this study analyzed the differences between the 8E learning cycle model and the online (conventional) expository model with Instagram in overcoming student misconceptions about buffer solution materials. This research method is a quasi-experiment with a non-equivalent control group design. Data collection used a three-tier multiple choice test technique and five experts' validated student response questionnaires. The sampling technique uses purposive sampling. Data analysis techniques use descriptive and inferential analysis of t-tests. The t-test is used to analyze the difference in concept understanding learning outcomes between the experimental and control classes to determine the effectiveness of the 8E learning cycle model. The results showed there were significant differences in concept understanding and misconceptions between experimental class students and control class students (0.00<0.05). Experimental class concept understanding was higher (43.62%) than the control class (28.95%), and experimental class misconception was lower (40.76%) than the control class (47.81%). From these data, it can be concluded that the application of the 8E learning cycle model is more effective than the expository (conventional) online model in overcoming misconceptions in buffer solution materials. The 8E learning cycle model can be an alternative to overcome misconceptions and improve students' understanding of concepts in buffer solution materials.

Keywords: buffer solution, learning cycle 8E model, misconceptions

DOI: https://doi.org/10.15575/jtk.v7i2.20494

1. Introduction

Education has the most important process, which is learning. The purpose of learning chemistry is to understand the concepts, principles, laws, and theories of interconnected substance change to overcome environmental problems (Usu et al., 2019). Students construct an understanding of chemistry learning by utilizing a combination of macroscopic, sub-microscopic, and symbolic representations (Pikoli, 2020). The understanding of concepts today is achieved by models or strategies that refer to the 2013 curriculum, where the learning process is student-centered. The main goal is to bring out good and deeper abilities (Waseso, 2018). Student-centered learning has become limited due to the pandemic situation, which requires students to learn online. Online learning is applied to remove physical barriers as a learning factor in the scope of the classroom (Riaz, 2018). The solutions applied have not been able to eliminate the impact on students who need help understanding a concept being taught. Misconceptions are already occurring in chemistry learning, even before online learning is applied.

Research by Usu et al. (2019) states that students who experience misconceptions due to abstract chemical materials require a deep understanding. Another reason is that students must use multi-representation, which are macroscopic, symbolic and sub-microscopic. The inability to connect these three types of representations is the main reason for misconceptions in chemistry learning (A'yun & Suyono, 2020). In addition, research by Nasrudin & Azizah (2020) states that misconceptions have internal factors in the form of initial knowledge brought by students before entering the classroom. A wrong understanding of a concept will be related to understanding another, so chemistry learning becomes complicated because it must understand each concept correctly.

A buffer solution is a material that must be considered for high misconceptions. Research by Agustiyaningsih & Azizah (2019) that three main points become misconceptions, which are the definition of buffer solution, the pH of buffer solution, and the working principle of buffer solution. The student's lack of interest and the lack of explanation of basic concepts and models used when learning are additional factors for the high level of misconceptions in buffer solution materials (Jannah et al., 2017).

Misconceptions experienced by students can be overcome by applying the learning cycle. Cyclical learning can lead students to a more meaningful process so that their understanding of chemical matter will increase. Cycle learning can train the integration of student abilities such as analytical thinking ability and science processability (Mustafa & Suyanta, 2019). This is supported by research by Rahmawati et al. (2019) shows that cyclical learning can increase the creativity and understanding of students from the cognitive structure depicted on the worksheet.

Along with the development of the age of learning cycles also experienced the development process of the 3E, 5E, 7E, and 8E learning cycle models. In this study, the 8E learning cycle model was used to overcome student misconceptions, which has corrected several shortcomings, one of which is adding a stage that allows students to find information in the digital world to overcome fundamental problems. The 8E learning cycle model can be applied to reduce misconceptions in students. In contrast to the discovery learning model, which does not have a stage for exploring their knowledge. This impacts the difficulty of evaluating and reflecting on learning because the knowledge formed needs to be more diverse.

Instagram is a popular media and can be used as a learning media for the 8E learning cycle model. Students in high school are millennials who mostly use Instagram. Using Instagram means that the learning process will follow habits and become an interest to bring out the desire to learn students (Mushlihah et al., 2018).

The use of 8E learning cycle model integrated with Instagram can be used in the evaluation of online learning which is different from the usual discovery learning which tends to be done offline (outside the network). This model can be meaningful learning when combined with online learning because it creates student-centered learning to achieve an understanding of concepts that are in accordance with actual understanding (Rahmawati et al., 2019).

Based on this description, research was carried out on the applying E-learning cycle model assisted by Instagram in overcoming the understanding of student concepts in the buffer solution material at SMA Negeri 2 Banjarmasin. This research is interesting because online learning turns can be meaningful and student-centered learning with the help of social media closest to them.

2. Research Method

2.1. Types of Research

This study used a quasi-experimental method (quasi-experiment) through a pretest-posttest non-equivalent control group design to measure the understanding and misconceptions of students. Pseudo-experimental research uses qualitative and quantitative tests (t-tests) to describe differences in students' understanding and misconceptions about buffer solution materials.

2.2. Population and Samples

The research population is 11th grade of science high school at SMA Negeri 2 Banjarmasin. The sample was taken by the random sampling method. The sample consisted of 33 participants from the experimental class and 33 participants from the control classes.

2.3. Research Instruments

Data were collected using perception tests with three-tier multiple-choice instruments that were tested at the beginning and end of learning (Gurel et al., 2015). The non-test technique used is in the form of a learning model response questionnaire in the experimental class. The test instruments that have been developed are validated by five experts in the field of chemistry and the reliability of the instruments that have been tested.

2.4. Research Procedures

Data were obtained by giving preliminary tests before and final tests after treatment given to students of experimental and control classes. Before the test is carried out, the instrument has been validated by 5 experts and tested on similar samples. The instrument shows that the instrument item is valid and reliable, so it is used as a data collection instrument.

2.5. Data Analysis Techniques

The data obtained were analyzed descriptively (N-gain) to determine the effectiveness of changes in understanding and misconceptions in control and experiment classes. Meanwhile, differences in understanding and misconceptions between control classes and experiment classes use inferential analysis (t-test), with normality and homogeneity tests as a precondition.

3. Result and Discussion

The different tests were analyzed in experimental class using the 8E learning cycle model and in the control class using the expository model. Experimental and control classes are treated with learning carried out online with the help of media in the form of Instagram content.

The use of the 8E learning cycle model has a more positive impact when compared to the expository model. In the experimental class, students are actively involved and able to explore their abilities more deeply. In contrast to the control class, students do not provide an active role during the learning process.

3.1. The Results of a Descriptive Analysis of Concept Understanding

Improved understanding of students' concepts before and after treatment was analyzed using N-gain calculation data. N-gain is carried out on data resulting from understanding the concepts of students which are then categorized. N-gains are shown in Table 1.

Table 1. N-Gain Understanding of Students' Concepts

Class	Average N-gain	Category
Experiment	0.56	Medium
Control	0.47	Medium

Table 1 showed the average value of the N-gain. The experimental class has a higher N-gain value than the control class, although it is in the same category. A greater N-gain in experimental class students showed a better improvement in concept mastery than in the control class. The percentage of students' understanding of concepts is shown in Table 2.

Table 2. Percentage of Understanding of The Concept of Students

Criteria	Class Experiment		Class Control	
	Pre-test	***Post-test***	***Pre-test***	***Post-test***
Understand the Concept	5.90%	43.62 %	10.10%	28.95%
Misconceptions	42.48%	40.76 %	18.29 %	47.81%
Not Understanding the concept	51.62%	15.62%	71.62%	23.24%

Table 2. shows that after the treatment was given, the percentage of pre-test understanding of concepts from both the experimental and control classes was very poor value. The percentage of understanding the concept from the experimental class showed a good increase indicated by a percentage increase of 37.72%. However, in the control class, the percentage of understanding the concept only increased by 18.80%. The percentage of misconceptions from the experimental class showed a decrease of 1.72%, but the percentage of misconceptions from the control class showed an increase of 29.52%. The percentage of not understanding concepts in the experimental class decreased by 36.00% and in the control class also decreased by 48.38%.

The level of understanding of the concept of the experimental class in the buffer solution material categorized in three parts can be seen in Figure 1 and Figure 2. The diagram shows the percentage result of the level of understanding of the concepts of the experimental class and the control class on each indicator.

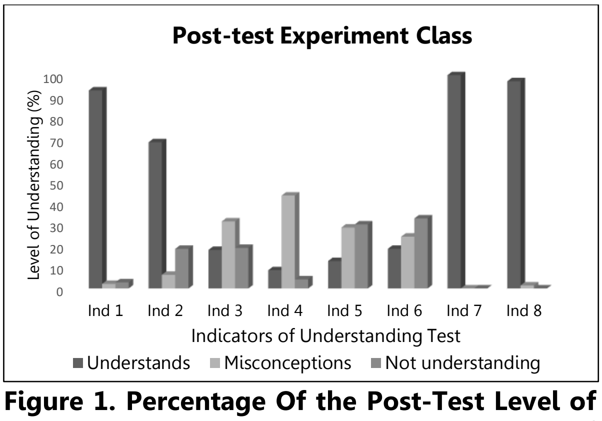

Figure 1. Percentage Of the Post-Test Level of Concept Understanding of Experimental Class Studetns for Each Indicator on The Buffer Solution Material

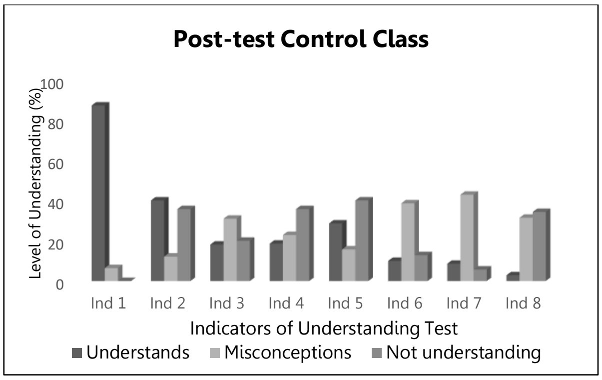

Figure 2. Percentage of the Post-Test Level of Concept Understanding of Control Class Students for Each Indicator on The Buffer Solution Material

3.2. Results of Inferential Analysis of Concept Understanding

Preliminary tests (normality and homogeneity) were performed before inferential analysis using t-tests was carried out. This test was performed on the pre-test, post-test, and N-gain data in the control class and experimental class classes. Homogeneity and normality tests showed that the pre-test, post-test and N-gain data of the two classes had normal distribution and showed that the data variants in the two classes were not different so the data were declared homogeneous. T-test data is shown on Table 3.

After the treatment is given a t-test value that indicates a sig. (2-tailed) < α (degree of significance). It can be concluded that H1 is accepted, meaning that there is a significant difference in concept understanding ability between the control class and the experimental class after being given treatment. There is a significant difference in understanding of the concept between the two classes of experimentation and control after being given treatment.

Table 3. T-Test of Learner Concept Understanding

Result	Class	db	α	Sig. (2-tailed)	Conclusion
Pre-test	Experiment Control	68	0.05	0.66	No difference
Post-test	Experiment Control	68	0.05	0.00	There are differences
N-gain	Experiment Control	68	0.05	0.00	There are differences

3.3. Discussion

The cycle 8E learning model is used in experimental classes and uses an online (conventional) expository model. Both classes are assisted by Instagram as a media for students to help fulfill learning materials. Learning activities in the experimental class consist of engaging, exploring, e-search, elaborating, exchanging, extending, evaluating, and explaining (Rahmawati et al., 2019).

The application of the Instagram-assisted model is a driver in maximizing learning to be more fun, contributing to interacting with positive content. The 8E learning cycle model in the research of Salyani et al. (2020) can reduce misconceptions about chemical bond materials. Hence, it supports students to extract information from various sources and reveal it in the form of mature concepts. Student-centered activities in the application of the 8E learning cycle model with multi-representation on learning evaluation, causing learning to be more meaningful. In addition, the impact felt by students is that their understanding of concepts is better and stronger (Safitri et al., 2020).

The initial knowledge between the experimental class and the control class is slight difference. The abilities of the students in the experimental class are more evenly distributed than in the control class. In the control class, there are students who already have good initial knowledge before entering the classroom. It is shown in the results of the analysis carried out. In addition, strict supervision of students is carried out in ensuring the ability of students when the test is carried out online or face-to-face.

Misconceptions are reduced in the experimental class and are different from the improved control class. This is also directly proportional to the understanding of students' concepts which is higher in the experimental class when compared to the control class. Fajriani et al. (2019) say that misconceptions must have been possessed by everyone who has innate knowledge and does not understand the concept of knowledge as a whole. Associative thinking, the stage of cognitive development, and the lack of interest of students are important factors to pay attention to before the learning process. Associative thinking often makes students generalize or unite concepts with other concepts, causing misconceptions. This will affect the attention and readiness of students in accepting new materials and concepts, differences in grasping power and thinking power as well as initial knowledge of students (Usu et al., 2019).

The percentage of not understand concepts in the experimental class before learning is converted into conceptual understanding. Thus, the percentage of understanding the concept increases. However, in the control class, the percentage of not understanding concepts high in the pre-test converted into misconceptions which results in a greater percentage of misconceptions after learning (can be seen in Table 2). This is supported by the research of Bere et al. (2019) which shows that the learning cycle approach can minimize or overcome misconceptions and improve understanding of concepts when compared to conventional learning.

The understanding of the concept of the experimental class is higher than that of the control class, indicated by the uniform results of a series of analyses carried out on the pre-test, post-test, and N-gain values. The lack of a level of understanding of concepts in the control class is also expressed in the average results of the N-gain of the experimental class and the control class showing differences, although both the N-gain of the experimental class and the control are in the same category. Based on the N-gain value, students in the experimental class are distributed in the high and medium categories, in contrast to the control class which is only distributed in the medium category. This is reinforced by the significant difference between the experimental class and the control class which can be seen in Table 3. The results of the concept understanding analysis also illustrate that misconceptions in the experimental class are lower than in the control class. The difference in student achievement is due to the fact that the experimental class uses the 8E learning cycle model, while the control class uses a conventional online model (school standards adapted from expository models). With this, there are significant differences, indicating that the 8E learning cycle model is more effectively used to improve conceptual understanding and overcome students' misconceptions about buffer solution materials.

Indicators of buffer solutions with the highest level of conceptual understanding in the experimental class are the role of buffer solutions in daily life and determining the composition of the buffer solutions made (Indicators 1, 7, and 8). A high understanding of the concept is caused because at every meeting students in the experimental class are faced with buffer solution problems related to daily life, as well as mathematical problems in calculating the composition of the buffer solution. Problems in everyday life stimulate students to think more critically and can increase their understanding of students' concepts (Santi et al., 2018).

Indicators of buffer solutions with the highest degree of misconception are found in the experimental class, which is about the working principle of buffer solutions when acids or bases are added and dilution (Figure 1. Indicator 4). This indicator provides conceptual problems that are described sub-microscopically and symbolically. Therefore, students must deeply understand the representation of each molecule involved and changing. In addition, students are required to understand basic concepts and look for correct logic. In line with the results of Pikoli's research (2020) that the understanding of concepts will be formed if students understand macroscopic, symbolic, and sub-microscopic representations.

The indicator of buffer solution material with the highest level of understanding in the control class is about the meaning of buffer solution (Figure 2. Indicator 1). The definition of buffer solution is the most basic indicator in the discussion of buffer solutions and is conceptual. Therefore, this is because this concept is simple and is used in general in understanding the function of buffer solutions as solutions that are able to maintain pH.

The indicator of buffer solution material with the highest level of misconception in the control class is the capacity of the buffer solution. Learning in the control class focuses on determining pH with simple mathematical calculations and is less associated with everyday phenomena. Students do not have sufficient knowledge and ability in overcoming various problems. In the research of Simamora et al. (2018), the lack of ability to calculate adversely affects the understanding of science (buffer solutions) because students are unable to understand the concept of more systematic calculations and are not able to analyze precisely the function of buffer solutions if faced with everyday phenomena.

In the experimental and control class, the indicator that has the highest average percentage is the material of the buffer solution which is conceptual. This shows that conceptual material will be more easily absorbed by students in the 8E learning cycle model and expository online. The difference is that the level of understanding of concepts in the experimental class is much higher than that of the control class (75.05 > 69.21). This finding is in line with the research of

Rahmawati et al. (2019) that the application of the 8E learning cycle model has a positive effect on the understanding of student concepts when compared to conventional learning. This is also in line with research conducted by Salyani et al. (2020) which states that cyclical learning has a significant influence on the learning outcomes of chemistry students.

There are other assumptions related to the high misconceptions of students in experimental classes and control classes. The limitations of the information absorbed and the lack of learning motivation based on constructivist learning are something that needs to be considered (Waseso, 2018). During online learning, teachers and students do not meet in person. Therefore, teachers are less able to generate motivation in students to absorb the information taught, and interest in learning is reduced. Lack of attention becomes a very decisive factor in the process of building understanding in students. However, if motivation and limitations in absorbing information are important factors in the process of understanding concepts, learning cycle 8E is better able to overcome the limitations of understanding concepts than classes that use online (conventional) expository models.

Suyono's research (2020) showed that chemistry learning that does not accommodate material that is beneficial to the environment tends to experience high misconceptions, even though remediation has been carried out on sub-materials that have experienced misconceptions. Including in the buffer solution material, misconceptions that occur in sub-matter are mathematical and the principle learned but cannot be useful in everyday life. This causes students to be less motivated in understanding and the absorption of knowledge is reduced, resulting in misconceptions. One of the solutions offered in this study is to provide additional supplements to learning, such as stunning videos and animations and even the connected web to provide a connection between the sub-material taught to the desired environmental benefits. Therefore, chemical sub-materials are abstract even though they are carried out with interesting learning, but cannot be useful in everyday life. It will be more difficult for students to understand the concept.

The next assumption, if the discussion of the comparison of understanding concepts and misconceptions between the two classes is set aside first, it appears that the misconceptions are still high in both classes. This is still a discussion that needs to be completed, although the experimental class has experienced better development in understanding concepts when compared to the control class. Students are able to answer correctly when the questions given are the same or similar to the examples given. However, in different types of questions even with the same formula, there is a high misconception. This is because plagiarizing behavior has become a culture and the inability of students to answer problems according to their concepts is inversely proportional to their cognitive abilities or structures. In another sense, students still lack the required level of understanding (Strangfeld, 2019).

Kurt Lewin's cognitive field theory states that learning takes place as a result of changes within cognitive structures (Duch, 2017). This statement reinforces that both types of learning models are still unable to overcome some of the factors that cause misconceptions in the buffer solution material. However, this does not mean that the model used is bad in both classes, but there is another discussion regarding the factors that make students still experience misconceptions. Multi-level representation-based learning is a solution to overcoming misconceptions, but it does not cover all the materials taught. Such as "how to relate the pH calculation and the working principle of the buffer solution with all three levels of representation". Learning can load from one or both types of representations, but it will be difficult if it contains all three types of representations at once. This difficulty does not only occur for students in understanding the material, but also for teachers in making learning tools.

The misconceptions that occur in students in the experimental class and the control class are relatively the same. However, the control class has a higher percentage of misconception categories than the experimental class. Misconceptions occur based on the descriptions of the students in the worksheet and then the results are reflected in the given concept understanding test. The misconceptions that occur will be corrected during the treatment into simple concepts that the learner understands. Table 4. shows some misconceptions that occur in both the students of the experimental class and the control class.

Some of the misconceptions and concepts formed after learning in the experimental and control classes on buffer solution materials are shown in Table 4. Misconceptions that are difficult to overcome in online learning on buffer solution materials are related to sub-materials that are mathematical, such as calculating pH and working principles in buffer solutions. Sub-matter of a mathematical nature is difficult to understand due to the incomprehension regarding simple stoichiometry (calculating the mole of concentration, mass, and the number of moles reacting) in chemistry learning.

The learning of buffer solutions in the control class is related to the pH calculation sub-material and the working principle of the buffer solution is lower in its misconception than in the experimental class. However, many are distributed in the part of not understanding the concept even after being given treatment. This means that mathematical sub-materials are difficult for students to understand because more in-depth analysis is needed with a combination of several concepts that must be explained directly. This is in line with the opinion of Tambunan (2019) stated that there is a significant difference in chemistry learning achievement between students who have low and high mathematical abilities.

The concepts formed after treatment in the experimental class are higher when compared to the control class seen in Figure 1 and Figure 2. This is because the 8E learning cycle model is more effective in generating an understanding of concepts and overcoming misconceptions than online (conventional) expository learning in chemistry learning materials. According to Arfianawati et al. (2016), expository learning is not always bad in every learning material, but because chemistry learning is experimental and scientific, conventional teacher-centered learning becomes less effectively used in chemistry learning.

Learning with the 8E learning cycle model gives more responsibility to students in the learning process. Then, the learner as the subject of the learner has more space in exposing the learning, so the teacher is only a guide, facilitator, and motivator. In other words, students will experience a deeper understanding of concepts with proper knowledge construction.

From a series of tests carried out, in the experimental class that applies the 8E learning cycle model, it is required to find, understand and build their knowledge, as well as connect some concepts found with existing problems. This causes students to be more critical in understanding the material being taught than in control classes that apply a standard online model adapted from conventional offline learning (expository). In the control class, only a few students are active in interacting and doing the given questions. Meanwhile, other students just stay silently waiting for their active group of friends to do the questions, so that when given individual questions, passive students cannot do it.

Table 4. Misconceptions and Concepts Between Before and After Treatment

No	Sub-materials	Misconceptions	Concepts
		Before treatment	After treatment
1.	Definition of buffer solution	A high pH is more acidic than a lower pH Examples: • the addition of a small amount of acid to the buffer solution will cause a slight increase in pH • The addition of a small amount of base to the buffer solution will lead to a slight decrease in pH	A high pH is more alkaline than a lower pH, on the contrary, a lower pH is more acidic than a higher pH Examples: • the addition of a small amount of acid to the buffer solution will lead to a slight decrease in pH • the addition of a small amount of base to the buffer solution will cause a slight increase in pH
2.	Components of acid or base buffer solutions	Dispersed speciation in the buffer solution comes only from formed salts and excess weak acids/bases with an irreversible reaction Examples: Buffer system: CH_3COOK/CH_3COOH • $CH_3COOK \rightarrow CH_3COO^- + K^+$ • $CH_3COOH \rightarrow CH_3COO^- + H^+$	Dispersed speciation in the buffer solution comes from the dissociation of formed salts and excess weak acids/bases with reversible reactions Examples: Buffer system: CH_3COOK/CH_3COOH • $CH_3COOK \rightarrow CH_3COO^- + K^+$ • $CH_3COOH \rightleftarrows CH_3COO^- + H^+$
		The H_2O molecule is derived from H_2^+ and O^-, then considers H_3O^+ different from H^+	The H_2O molecules is derived from H^+ and OH^-, then the speciation of H_3O^+ is the same to H^+ which is in the solvent (H_2O)
3.	Calculation of components and pH of the buffer solution	• An acid buffer solution that has $[H^+] > 10^{-7}$, so pH > 7 • An base buffer solution that has $[OH^-] > 10^{-7}$, so pOH > 7 Examples: Acid buffer solution $[H^+] = 10^{-8}$, maka pH = 8 (base)	If the buffer solution with $[H^+]$ and $[OH^-] < 10^{-7}$, then it will be affected by the speciation of H^+ and OH^- of H_2O so that the pH corresponds to the properties of the buffer solution Examples: $[H^+] = 10^{-8}$,if affected $[H^+]$ from H_2O so, $[H^+] = 1{,}1 \times 10^{-7}$, and pH = 7 – log 1,1
4.	Calculation of components and pH of the buffer solution	Using the number of moles of salt in the calculation of the buffer solution, because the mole of the conjugated acid /base is always the same as the mole of the salt. Examples: • $n(NH_4)_2SO_4$ (salt) = 1 mol • nNH_4^+ (conjugate acid) = 1 mol	Using the number of moles of conjugated acids/bases in the calculation of buffer solutions, because the moles of conjugated acids/bases are proportional to the number of valences contained in the salts Examples: • $n(NH_4)_2SO_4$ (salt) = 1 mol • $(NH_4)_2SO_4 \rightarrow 2NH_4^+ + SO_4^{2-}$ • nNH_4^+ (conjugate acid)= 2x1 mol = 2 mol
5.	The working principle of the buffer solution	In the acid buffer solution, the addition of acid will react with a weak acid so that the number of acid moles increases. On the contrary, the addition of bases will react with salts, so that the mole of the conjugation base increases. Examples: • $H^+ + HF \rightarrow 2HF$ • $OH^- + NaF \rightarrow NaOH + F^-$	In the acid buffer solution, the addition of acid will react with its conjugated base to form a weak acid, so that the number of moles of weak acid increases, on the contrary, the addition of a base will react with weak acids to form a conjugated base so that the mole of the conjugated base increases. Examples: • $H^+ + F^- \rightleftarrows HF$ • $OH^- + HF \rightleftarrows F^- + H_2O$
6.	The role of buffer solutions	Knowing the buffer solution in everyday life, without knowing the molecules that play a role.	Knowing the buffer solution in everyday life, with knowing the molecules that play a role.

Based on the average value of the N-gain and N-gain t-test, it shows that the experimental class with the 8E learning cycle model is more effective in overcoming learner misconceptions. The results of the misconception showed that after being given treatment in the experimental class there was 11.43% decrease in low-level misconceptions, 14.28% decrease in moderate criteria, and a 2.86% decrease in high criteria. Then in the control class, there was 71.42% decrease in low criterion misconceptions, 62.86% decrease in medium criteria, and 8.56% increase in high criteria. The transfer of concept understanding from not understanding concepts to misconceptions in control classes is very significant because the low level of misconceptions at the beginning of learning indicates a high level of not understanding concepts (Table 2). which is then represented as an improvement on the misconceptions of medium criteria. In contrast to the experimental class, the transfer of concept understanding from not understanding concepts to misconceptions is not significant because before learning misconceptions in the experimental class are already in moderate criteria, so the understanding of concepts increases in percentage as the percentage of not understanding concepts decreases (Table 2).

In the experimental class, there were 43.62% of conceptual understanding category, while in the control class, it was only 28.95%. This shows that the experimental class with the 8E learning cycle model has learning stages that can improve conceptual understanding. At each stage of the 8E learning cycle model, it encourages students to understand and construct more in-depth material concepts (Rahmawati et al. 2019).

Expository online learning still tends to be teacher-centered. Maemanah et al. (2019) stated that the knowledge gained from teacher-centered learning is just transferring knowledge from teacher to student. This results in learning tend to be one-way so that it becomes less active and the results of the knowledge gained become less meaningful.

Another consideration that should be discussed as a high misconception is the inability of three-tier multiple-choice instruments to more accurately distinguish categories of learner understanding. In Nurulwati & Rahmadani's research (2019) showed that three-tier multiple-choice instruments have a higher number of misconceptions than four-tier multiple-choice instruments. Research by Nurhidayatulah & Prodjosantoso (2018) and Kustiarini et al. (2019) also mentioned that 35% to 50% of misconceptions occurred in students measured using similar instruments in buffer solution material. The sub-matter that has experienced the most misconceptions is the calculation of pH and the working principle of the buffer solution. Then, it is strengthened by the opinion of Gurel et al. (2015) who stated that three-tier multiple choice is less able to measure misconceptions and less accurate than four-tier multiple choice. Three-tier multiple choices simplify the proportion of not understanding the concept based solely on belief in the answer at the first or second level. It also shows that the three-tier multiple choice instrument simplifies the categorization of the learner's understanding of concepts.

This raises a new question if the learner's ability is measured using a four-tier multiple choice instrument or another misconception meter, "will it describe a similar or different result to a three-tier multiple-choice measurement?". If other instruments show better results, it is not impossible that three-tier multiple-choice instruments have become irrelevant in measuring misconceptions. This certainly gives rise to new ideas that subsequent researchers should consider so as not to use three-tier multiple-choice instruments in analyzing student misconceptions.

4. Conclusion

In the buffer solution material, there is a positive and significant difference between the application of the 8E learning cycle model and the conventional (online) model in overcoming student misconceptions. Students using the 8E learning cycle model have a higher understanding of concepts and lower misconceptions than control classes that use conventional (online) models. Students with a high level of misconceptions show two possibilities, which is understanding concept or not understanding concept. The 8E learning cycle model is expected to be an alternative to blended learning to overcome misconceptions and increase students' understanding of concepts. Researchers who apply the 8E learning cycle model are required to design time allocation well so that the learning process can run more effectively.

References

A'yun, K., & Suyono. (2020). Hubungan tingkat konflik kognitif terhadap beban miskonsepsi mahasiswa calon guru kimia. *Uniqbu Journal of Exact Sciences (UJES)*, *1*(April), 41–45. https://doi.org/10.47323/ujes.v1i1.6

Agustiyaningsih, S., & Azizah, U. (2019). Reduce misconception of students on buffer. *In National Seminar on Chemistry*, *1*(Snk), 239–245. https://doi.org/10.2991/snk-19.2019.51

Arfianawati, S., Sudarmin, S., & Sumarni, W. (2016). Model pembelajaran kimia berbasis etnosains untuk meningkatkan kemampuan berpikir kritis siswa. *Jurnal Pengajaran MIPA*, *21*(1), 46-51. https://doi.org/10.18269/jpmipa.v21i1.36256

Bere, V. P., Pranata, K. B. P., & Jufriadi, A. (2019). Penerapan model pembelejaran learning cycle 5E berbasis eksperimen untuk meningkatkan pemahaman konsep dan mereduksi miskonsepsi siswa. *Seminar Nasional Pendidikan*, 152–157. Retrieved from https://snpfmotogpe.ulm.ac.id/proceeding/index.php/snpf/article/view/64

Duch, W. (2017). Kurt Lewin, psychological constructs and sources of brain cognitive activity. *arXiv preprint arXiv:1711.01767*. https://doi.org/10.48550/arXiv.1711.01767

Fajriani, G. N., Sopandi, W., & Kadarohman, A. (2019). Miskonsepsi siswa yang menggunakan teks perubahan konseptual mengenai hukum-hukum dasar kimia. *Orbital: Jurnal Pendidikan Kimia*, *3*(1), 30–41. https://doi.org/10.19109/ojpk.v3i1.3361

Gurel, D. K., Eryilmaz, A., & McDermott, L. C. (2015). A review and comparison of diagnostic instruments to identify students' misconceptions in science. *Eurasia Journal of Mathematics, Science and Technology Education*, *11*(5), 989–1008. https://doi.org/10.12973/eurasia.2015.1369a

Jannah, M., Ningsih, P., & Ratman. (2017). Analisis miskonsepsi siswa kelas XI SMA negeri 1 banawa tengah pada pembelajaran larutan penyangga dengan CRI (certainty of response index). *Jurnal Akademika Kimia*, *5*(2), 86–90. Retrieved from http://jurnal.untad.ac.id/jurnal/index.php/JAK/article/view/8019

Kustiarini, F. T., VH, Efi. S., & Saputro, A. N. C. Penggunaan tes diagnostik three-tier test alasan terbuka untuk mengidentifikasi miskonsepsi larutan. *Jurnal Pendidikan Kimia,* *8*(2), 171-178. https://doi.org/10.20961/jpkim.v8i2.25236

Maemanah, S., Suryaningsih, S., & Yunita, L. (2019). Kemampuan pemecahan masalah melalui model flipped classroom pada pembelajaran kimia abad ke 21 orbital. *Orbital: Jurnal Pendidikan Kimia*, *3*(2), 143-154. https://doi.org/10.19109/ojpk.v3i2.4901

Mushlihah, K., Yetri, & Tuberti. (2018). Pengembangan media pembelajaran berbasis multi representasi bermuatan sains keislaman dengan output instagram pada materi hukum newton development learning material principle multi representasi contain sains islam religious with instagram output on lesson newton law. *Indonesian Journal of Science and Mathematics Education*, *1*(3), 207–2015. Retrieved from https://ejournal.radenintan.ac.id/index.php/IJSME/index

Mustafa, L. K., & Suyanta. (2019). Exploring students' integrated ability and creativity: using 7E learning cycle model in chemistry learning. *Journal of Physics: Conference Series*, *1233*(1). https://doi.org/10.1088/1742-6596/1233/1/012019

Nasrudin, H., & Azizah, U. (2020). Overcoming misconception in energetic topics through implementation of metacognitive skills-based instructional materials: a case study in student of chemistry department, universitas negeri surabaya. *JPII*, *9*(1), 125–134. https://doi.org/10.15294/jpii.v9i1

Nurhidayatulah, N., & Prodjosantoso, A. K. (2018). Miskonsepsi materi larutan penyangga. *Jurnal Inovasi Pendidikan IPA*, *4*(1), 41–51. https://doi.org/10.21831/jipi.v4i1.10029

Nurulwati, N., & Rahmadani, A. (2020). Perbandingan hasil diagnostik miskonsepsi menggunakan threetier dan fourtier diagnostic test pada materi gerak lurus. *Jurnal Pendidikan Sains Indonesia*, *7*(2), 101–110. https://doi.org/10.24815/jpsi.v7i2.14436

Pikoli, M. (2020). International journal of active learning using guided inquiry learning with multiple representations to reduce misconceptions of chemistry teacher candidates on acid-base concept. *International Journal of Active Learning*, *5*(1), 1–10. Retrieved from http://journal.unnes.ac.id/nju/index.php/ijal

Rahmawati, Y., Ridwan, A., Faustine, S., Auliyani, C. N., Kartika, I. R., & Rafiuddin, R. (2019). Chemistry students' cognitive structures in oxidation-reduction, through an 8E learning cycle. *Journal of Physics: Conference Series*, *1402*(5). https://doi.org/10.1088/1742-6596/1402/5/055053

Riaz, A. (2018, July 17-19). *Effects of online education on encoding and decoding process of students and teachers*. [Conference Presentation]. International Association for Development of the Information Society (IADIS) International Conference on e-Learning, Madrid, Spain. Retrieved from https://files.eric.ed.gov/fulltext/ED590288.pdf.

Safitri, L., Winarti, A., & Suharto, B. (2020). Analysis of understanding the concept of macroscopic – submicroscopic - symbolic using submicroscopic approach in acid base solution materials. *JCAE: Journal of Chemistry and Education*, *4*(1), 16–23. https://doi.org/10.20527/jcae.v4i1.527

Salyani, R., Nurmaliah, C., & Mahidin, M. (2020). Application of the 5E learning cycle model to overcome misconception and increase student learning activities in learning chemical bonding. *Journal of Physics: Conference Series*, *1460*(1). https://doi.org/10.1088/1742-6596/1460/1/012102

Santi, N., Soendjoto, A., & Winarti, A. (2018). Critical thinking ability of biology education students through solving environmental problems. *BIOEDUKASI: Jurnal Pendidikan Biologi*, *11*(1), 35–39. https://doi.org/10.20961/bioedukasi-uns.v11i1.19738

Simamora, R. E., Saragih, S., & Hasratuddin, H. (2018). Improving students' mathematical problem-solving ability and self-efficacy through guided discovery learning in local culture context. *International Electronic Journal of Mathematics Education*, *14*(1). https://doi.org/10.12973/iejme/3966

Strangfeld, J. A. (2019). I just don't want to be judged: cultural capital's impact on student plagiarism. *SAGE Open*, *9*(1). https://doi.org/10.1177/2158244018822382

Suyono. (2020). Miskonsepsi kimia, sebuah misteri. *Jurnal Pembelajaran Kimia OJS*, *5*(1), 1–7. http://dx.doi.org/10.17977/um026v5i12020p001

Tambunan, H. (2019). The effectiveness of the problem-solving strategy and the scientific approach to students' mathematical capabilities in high order thinking skills. *International Electronic Journal of Mathematics Education*, *14*(2). https://doi.org/10.29333/iejme/5715

Usu, N., Rahmanipu, & Marhadi, M. A. (2019). Analisis miskonsepsi siswa pada materi kesetimbangan kimia menggunakan tes diagnostik two tier multiple choice. *Jurnal Pendidikan Kimia FKIP Universitas HaluOleo*, *4*(3), 226-237. http://dx.doi.org/10.36709/jpkim.v4i3.11738

Waseso, H. P. (2018). Kurikulum 2013 dalam prespektif teori pembelajaran konstruktivis. *TA'LIM: Jurnal Studi Pendidikan Islam*, *1*(1), 59-72. https://doi.org/10.52166/talim.v1i1.632