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Research Artikel

DUAL SITUATED LEARNING MODEL AS REMEDIAL TEACHING TO ACID-BASE MISCONCEPTIONS

DUAL SITUATED LEARNING MODEL SEBAGAI REMEDIAL TEACHING UNTUK MISKONSEPSI ASAM BASA

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Abstract

The research aimed to determine whether or not there is an acid-base misconception using a three-tier multiple choice format and the effectiveness of using DSLM in reducing these misconceptions. The research design is descriptive qualitative research with a case study approach. The sampling technique used was purposive sampling, so the sample is a student of classes XI MIPA 1 and XI MIPA 5. The data collection technique was through three-tier multiple-choice tests, learning with DSLM, and interviews. After the first TTMC test, the researcher conducted remedial teaching with DSLM to improve the acid-base misconception. The results of the research showed that as many as 29 out of 61 students had misconceptions about different sub-concepts. Most of the students had misconceptions about such things as the characteristics of acid-base solutions, acid-base theories, pH concepts, the strength of acids and bases, the electrolytes of acid and base solutions, and neutralization reactions. After the researcher did DSLM learning, there was a decrease in misconceptions from 48.14% to 27.02% (low misconceptions category). It shows that DSLM can be an effective strategy to reduce student misconceptions.

Keywords*: Acid-base; misconception; three tier multiple-choice; remedial teaching DSLM.*

Abstrak

Penelitian ini bertujuan untuk mengetahui ada atau tidaknya miskonsepsi asam basa menggunakan three-tier multiple choice dan efektivitas penggunaan DSLM dalam mereduksi miskonsepsi tersebut. Desain penelitian merupakan penelitian kualitatif deskriptif dengan pendekatan studi kasus. Pengambilan sampel menggunakan teknik purposive sampling sehingga didapat siswa kelas XI MIPA 1 dan MIPA 5. Teknik pengumpulan data melalui hasil three-tier multiple choice, pembelajaran DSLM dan wawancara. Setelah uji TTMC pertama, dilakukan remedial teaching dengan DSLM untuk memperbaiki konsep asam basa yang menjadi miskonsepsi. Hasil penelitian menunjukkan sebanyak 29 dari 61 siswa mengalami miskonsepsi pada sub konsep yang berbeda-beda. Sub konsep tersebut ialah karakteristik larutan asam basa, teori asam basa, kekuatan asam dan basa, derajat keasaman (pH), keelektrolitan larutan asam dan basa, serta reaksi netralisasi. Setelah melakukan pembelajaran DSLM, terjadi penurunan miskonsepsi dari 48,14% menjadi 27,02% (kategori miskonsepsi rendah). Hal ini menunjukkan bahwa DSLM dapat menjadi strategi yang cukup efektif dalam mereduksi miskonsepsi siswa.

Keywords*: Asam basa; miskonsepsi; three-tier multiple choice; remedial teaching; DSLM.*

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INTRODUCTION

Learning is a two-way process between teachers and students involving aspects of knowledge, attitudes, and skills to achieve the goals that have been set. Implementation of the 2013 curriculum requires the application of these aspects to improve student competencies and answer the challenges of the 21st century that are relevant and accountable. The existence of an integrative curriculum can encourage students' creativity and cooperation in studying material concepts correctly and deeply. Chemistry is a complex material and contains a deep mastery of concepts. Misconceptions in chemistry learning have been widely studied such as chemical bonds (Özmen, 2004); acid-base (Cetin-Dindar & Geban, 2011; Cetingul & Geban, 2011; Pinarbasi, 2007); and electrochemical cell (Yürük, 2007).

Acid-base is a material that contains abstract concepts, defined concepts, chemical calculations, and graphs so that the material becomes more complex and requires in-depth understanding (Yunitasari et.al, 2019). The acid base is the starting material for studying buffer solutions and salt hydrolysis (Maratusholihah, Rahayu, & Fajaroh, 2017). The correct mastery of the basic materials is a top priority because the materials in chemistry are interrelated and multilevel.

The misconception is a phenomenon of different concepts between concepts understood or believed by students with actual concepts or concepts accepted by the scientific community (Nakhleh, 1992; Demircioglu et. al, 2005). Misconceptions can interfere with subsequent learning if the wrong concepts are integrated into students' cognitive structures can form a weak understanding. Misconceptions are resistant and difficult to eliminate (Yürük, 2007). Therefore, teachers must identify students' conceptual knowledge to prevent further misconceptions.

Identification of misconceptions in students can use the three-tier multiple choice (TTMC). The three-tier multiple choice is a more valid test instrument to identify students' misconceptions than one tier and two tiers (Peşman & Eryilmaz, 2010). In addition, it is easier and simpler to identify misconceptions and distinguish them from students who understand concepts, guess (error), misconceptions, and don't understand concepts by increasing the level of confidence in students' answers at the third level (Arslan et al., 2012). After identifying three-tier multiple choice, the teacher will know the existence of misconceptions and the location of the misconceptions.

The teacher's role is very important in providing solutions to overcome misconceptions. Teachers need to make remedial teaching efforts to improve concepts that become misconceptions, one of which is by implementing the Dual Situated Learning Model (DSLM). This learning is oriented to students' conceptual changes that will help students reduce the misconceptions they experience (Maratusholihah, Rahayu, & Fajaroh, 2017) and emphasize the concepts that students believe and according to scientific experts (She, 2002). DSLM has been effective in reducing misconceptions in the matter of air pressure (She, 2002); smelting and dissolving (She, 2004); photosynthesis and respiration (Akpinar, 2007); chemical equilibrium (Maharani, Effendy, & Yahmin, 2016) as well as salt hydrolysis and buffer solution (Maratusholihah et al., 2017). DSLM has the potential as a learning model to reduce misconceptions on acid-base material because it is done by giving dissonance or incompatibility with the initial concept and then providing a new mental set in the form of pictures, questions, and so on. This DSLM model guides students to change concepts through making predictions, giving reasons, confronting dissonance, and constructing new mental sets (Maharani et al., 2016).

Research conducted by Satriana, Yamtinah, Indriyanti, & Wijaya (2017) at SMAN 1 Surakarta shows that the concept of acid-base is the second most difficult material after stoichiometry. The identification of misconceptions has been carried out at SMAN 1 Surakarta using a three-tier multiple choice for 12th graders and shows that students experience misconceptions in the sub-concept such as acid-base theory (23.75%); acid-base strength (42.53%); the concept of pH in the environment (14.06%); and characteristics of acids and bases as electrolytes (42.71%) (Mubarokah, Mulyani, & Indriyanti, 2018). However, this research is only limited to identifying misconceptions. Amry et al. (2017) conducted a study to compare the effect of conventional learning and DSLM in identifying acid-base misconceptions using two-tier. The results showed that students who studied with DSLM experienced fewer misconceptions than the conventional model. However, this research has not made an effort to improve or reduce the understanding that is a misconception by students. Therefore, researchers are interested in identifying and remediation or correct the concepts that become misconceptions.

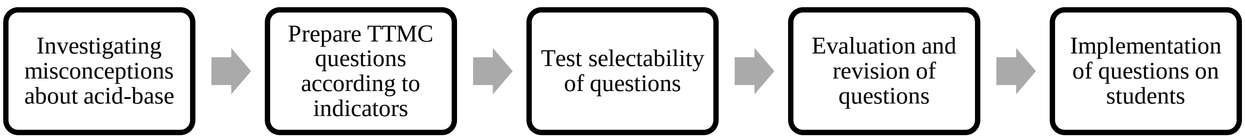
The results of pre-research observations show that teachers conduct direct learning quickly while students are required to be active and understand complex acid-base materials. The teacher only explains the basic concepts and calculation problems so that students may experience misconceptions. In addition, the results of an interview with a chemistry teacher in class XI of SMAN 1 Surakarta explained that acids and bases are difficult materials. There are many misconceptions in the Lewis theory, the strength of polyprotic acids and bases, neutralization reactions, and determination of pH for acids and bases with a valence of more than 1. The use of DSLM has never been done in SMA N 1 Surakarta.

Based on this description, researchers are interested in identifying misconceptions on acid-base material at SMAN 1 Surakarta using three-tier multiples choice with closed reasoning. After identification, the researcher conducted remedial teaching using DSLM learning. In this learning process, there is a Challenging Situated Learning Event (CSLE) to provide opportunities for students to be able to apply the mental set that has been obtained with new concepts so that students' misconceptions can be reduced or eliminated.

METHOD

The research was done at SMA N 1 Surakarta in the even semester of 2019/2020. The research design is descriptive and qualitative with a case study approach. The researcher describes and evaluates the results of data analysis so that the main findings can answer the formulation of the problem posed. The research subjects were all 11th-grade students of SMAN 1 Surakarta. The samples were from two superior science classes (IPA-1 and IPA-5). There are 33 students in science-1, while science-5 has 28 students, and the total is 61 students. The sampling technique used purposive sampling, namely the considerations based on the place and student intelligence. The selected class has many smart students, and previously they have studied the concept of acid and base.

The data collection technique consisted of a written test and a non-test. The written test is in the form of answers from three-tier multiple choice (TTMC) and the implementation is done two times. The first TTMC test is done before the implementation of the DSLM learning. The analysis result of the first test was used as initial data to determine the location of students' misconceptions, while the second test obtained after the DSLM was used to determine how much the students' misconceptions decreased. The steps for creating a three-level multiple choice are as follows.



While non-test data was obtained through:

a) Observation of the teacher during teaching acid-base material.

b) Remedial teaching activities with DSLM to reduce students' misconceptions.

c) Interviews with students who have misconceptions.

Content validity was used for the test questions and interview instruments. The validity test was measured based on the opinions of two experts (judgment experts) and resulted in a CV = 0.913 (TTMC test questions) and 0.950 (interview instruments). Based on that value, the question instrument is declared valid and feasible to use. In addition, the reliability test is 0.862, meaning that the questions are reliable and suitable to be used as an instrument for detecting chemical misconceptions on acid-base materials. The validity of the data is very important to measure the level of trust in research so that it can be responsible scientifically. Measurement of the data validity is done by triangulation as shown in Figure 1. The identification of misconceptions was carried out 2 times, namely: 1) The first TTMC was carried out before the implementation of DSLM; 2) The second TTMC is carried out after the implementation of DSLM.

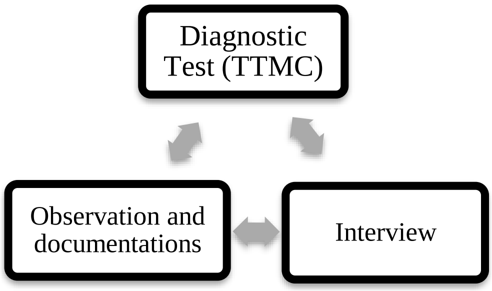


Figure 1. Triangulation Technique for Credibility

Table 1. All possibilities of responses from three-tier multiple choice (Arslan, et.al, 2012)

First tier	Second tier	Third tier	Categories
Correct	Correct	Certain	Scientific knowledge
Correct	Incorrect	Certain	Misconception (+)
Incorrect	Correct	Certain	Misconception (-)
Incorrect	Incorrect	Certain	Misconception
Correct	Correct	Uncertain	Error (E)
Correct	Incorrect	Uncertain	Lack of knowledge
Incorrect	Correct	Uncertain	Lack of knowledge
Incorrect	Incorrect	Uncertain	Lack of knowledge

RESULT AND DISCUSSION

The TTMC test consists of 20 questions and the results of the analysis state that each item contains misconceptions. In this article, the researcher only explained five questions because they had the highest level of misconception. Several misconceptions were found in each acid-base sub-material either before or after learning DSLM as presented in table 2.

Table 2. Percentage of Student Misconceptions Before and After DSLM

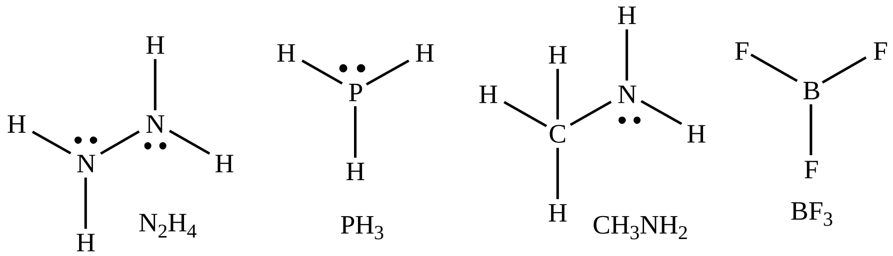
No	Misconceptions	Average (%) Before DSLM	Average (%) After DSLM
1.	**Acid-Base Theory** a) Acids are all compounds that contain H atoms and ionize in water to produce H^+ ions b) A substance that donates a pair of nonbonding electrons in acid-base reactions known as a Lewis acid.	52.47	14.76
2.	**Acid strength** a) The lower pH values affect the acid strength increases because the acid strength is affected by pH. b) The higher the pKa values affect the acid strength is increasing	70.50	27.87

3.	**Calculation of α value** Students use the $\alpha = \sqrt{\frac{Kb}{[OH^-]}}$ formula to calculate the value of the ionization degree of a weak base so that they assume the concentration of OH^- is the same as the concentration of BOH	63.93	49.18
4.	**The electrolyte of an acid-base solution** Only strong bases can conduct electricity because they have stronger covalent bonds than weak bases.	77.05	55.74
5.	**Calculation of pH value** a) Strong acid pH with a concentration of less than 10^{-7} has a pH value above 7 b) Calculation of acid pH with a concentration of less than 10^{-7} only uses the concentration of H^+ derived from HCl and ignores the concentration of H^+ from water	83.61	68.85

Description of Student's Misconception

1. Acid-Base Theory

Students identify compounds that are acids between BF_3, PH_3, N_2H_4, and CH_3NH_2. The acid compound is BF_3 because the B atom does not has a pair of nonbonding electrons so it can act as an electron-pair acceptor to bond to form a complex compound. While PH_3, N_2H_4, and CH_3NH_2 are bases because the N and P atoms have a pair of nonbonding electrons so they can donate a pair of nonbonding electrons in acid-base reactions.



The first TTMC showed that 52.47% of students had misconceptions. The findings of the misconceptions are as follows:

a) Acids are all compounds that contain H atoms and ionize in water to produce H^+ ions
b) A substance that donates a pair of nonbonding electrons in acid-base reactions known as a Lewis acid.

The correct concept is that not all compounds containing H atoms are acids. Three theories define acids and bases with different concepts. According to the Lewis theory, a substance that acts by accepting a pair of nonbonding electrons in chemical reactions is known as acid. A base is a substance that acts to donate a pair of nonbonding electrons in a chemical reaction (Amry, Rahayu, & Yahmin, 2017; Artdej, Ratanaroutai, Coll, & Thongpanchang, 2010).

Muchtar & Harizal (2012) reported that students considered the nature and all of the acid-base reactions to be explained by only one acid-base theory. Acids are all compounds that contain H atoms and bases if they contain an OH group. This understanding is the concept that most students understand and tends to lead to the Arrhenius definition of acids and bases. This concept is wrong because not all acid-base compounds can be identified with one concept, so it is necessary to refine the concept to explain the definition of acid-base. This analysis is supported by interviews with students who experience misconceptions. In fact, students already understand the definitions of the three theories of acid and base but they have difficulty determining examples of acids or bases because they lack an understanding of the concept of chemical bonds. This situation makes students only rely on one theory that is considered easy in identifying acids and bases. For example, PH_3 is considered acidic because there are H atoms without understanding the concept of electrons in the central atom.

2. Acid strength

Students can determine the acid strength of several compounds, namely HF, HNO_2, and

CH_3COOH. The order of acid strength from highest to lowest is HF > HNO_2 > CH_3COOH. This determination is based on the price of K_a. The smaller the degree of dissociation (α), the smaller the K_a value of a weak acid and the lower the acid strength. Based on TTMC 1, 22.95% of students understand the concept, and 70.50% of misconceptions. They assume that the lower the pH value, the stronger the acid because the pH value affects the strength of the acid, and the greater the pK_a, the stronger the acid.

Research conducted by Amry, et al. (2017) reported that 1% of students who studied with DSLM thought that the strength of the acid was influenced by pH because pH showed a large concentration of H^+ ion in the solution so the lower the pH, the stronger the acid. The data of the interview prove that students determine the strength of the acid just by looking at the pH value because the lowest pH has the greatest acid strength. The value of K_a is only a support and consider the strong acid can be seen from the H^+ ion concentration and pH value.

The correct concept is that acid strength is affected by the ability of an acid to ionize/dissociate in water which is indicated by the value of K_a. The smaller the value of K_a, the weaker the acid (Keenan, et al., 1980). The acid strength is not affected by the magnitude of the pH value. pH indicates the concentration of H^+ ions in solution and cannot be equated with the ability of a compound to ionize/dissociate in water. In addition, the pK_a value is obtained from $pK_a = -\log K_a$ so that the relationship between the two is that the lower the K_a value, the greater the pK_a value. The pK_a value is inversely proportional to the K_a value. The low K_a value indicates the degree of ionization is small or the number of ionized compounds decreases so that the acid strength decreases.

3. Calculation of α value

Students can calculate the α value of a base (valence 1) with a pH of 10 and a K_b of 10^{-5}. The calculation results show that the α value is 1×10^{-1}. Based on the first TTMC, 63.93% of students suffer from misconceptions. This misconception occurs because students calculate the degree of ionization of a weak base using $\alpha = \sqrt{\frac{Kb}{[OH^-]}}$ formula. The students consider $\alpha = \sqrt{\frac{K_b}{[BOH]}}$ is the same as $\sqrt{\frac{Kb}{[OH^-]}}$. The concentration of OH^- or $[OH^-]$ is the same as the concentration of a base solution or [BOH]. Interviews conducted by researchers proved that in calculating the α value, students use the concentration of OH^- ions instead of the concentration of alkaline solutions. The application of this concept applies to both monoprotic and polyprotic bases. Students need to understand this question that in a polyprotic base solution or the base valence is more than 1, so the concentration of the base solution is not the same as the concentration of OH^- so that the determination cannot use $[OH^-]$. Meanwhile, in monoprotic bases, the concentration of OH^- is equal to the concentration of the base solution.

Actually, the degree of dissociation of a weak base can be obtained by the $\alpha = \sqrt{\frac{K_b}{[BOH]}}$. The formula shows that $[OH^-]$ is different from [BOH]. [OH-] indicates the number of OH^- ions in a solution, while [BOH] shows the concentration of an alkaline solution (Mubarokah, Mulyani, & Indriyanti, 2018). The α value indicates the number of electrolyte molecules that dissociate into their ions. Electrolyte molecules that dissociate are solutions of weak bases not OH^- ions. This causes the calculation of α to use the concentration of a weak base solution (BOH) instead of the OH^- ion. Actually, the students understood the questions and answered correctly in first tier but incorrectly chose the reasons for second tier.

4. The electrolyte of an acid-base solution

Students determine a solution that can conduct an electric current between LiOH, NH_3, NaOH, and $C_6H_5NH_2$. The correct answer is that all base solutions can conduct electricity when dissolved in water. Based on TTMC 1, there are 47 students who have misconceptions. Students cannot determine a solution that conducts electric current but is able to correctly answer the reason why a solution is capable of being an electrolyte.

The misconception occurs when a base compound is dissolved in water, only a strong base can produce ions that can move freely in solution, and it has a stronger covalent bond strength than a weak base so that it can conduct an electric current. The correct concept is that all solutions of acids and bases can conduct electric current. Substances that can conduct electric current in solution are known as electrolytes (Keenan et al., 1980).

Many students experience misconceptions, possibly caused by students' understanding of the prerequisite material for studying chemical bonds and electrolyte solutions that are not deep. All acids and bases can be ionized to produce ions that move freely in solution. Acid or base compounds have two ionization patterns partially ionized (weakly ionized) and fully ionized. These two patterns form a strong electrolyte and a weak electrolyte. A strong electrolyte occurs when an electrolyte dissolves almost completely in the water while weak electrolytes don't dissolve completely. The chemical bonds of an acid or base are more difficult to break if the bonds between the atoms are strong so the ability of compound to ionize decreases. Weak acids and weak bases are weak electrolytes because their chemical bonds are stronger than strong acids and strong bases (Amry, et.al, 2017).

5. Calculation of pH value

Students can determine the pH of an acid solution with a low concentration. Based on the first TTMC, one student understands the concept, and 51 students have misconceptions. This question tests students' ability to determine the pH of HCl 10^{-8} M. Most students think the pH of HCl is 8 or 7. The results of TTMC 1 explain that 51 students know that the addition of acid H+ ions with low concentrations ($<10^{-7}$) will push the equilibrium to the left (H_2O) because there is an excess of H^+, so H^+ ion from the water is ignored. The correct concept is that HCl with a concentration of 10^{-8} M has a pH of 6.98, meaning that the pH is less than 7 at 25^0C. Calculation of the pH of HCl with a concentration of less than 10^{-7} M or very dilute should not ignore the H^+ concentration of water because in dilute conditions it must involve an equilibrium reaction of water (Abdullah, Rini, & Ardiansyah, 2020).

This misconception occurs because students assume that HCl with a concentration of 10^{-8} M will produce a pH of 8 because HCl is a strong acid, so it completely ionizes to produce H^+ and Cl^-. The concentration of H^+ ion used is the same as the concentration of HCl, which is 10^{-8} so the pH value is 8. Based on interviews, students only focus on the type of solution. HCl is a strong acid, and the pH calculation directly uses the formula pH = - log [H^+] so that the pH results are not following the classification of the type of solution. HCl is an acid but the student's answer HCl becomes a base.

This misconception is similar to research from Abdullah et al. (2020); Imaduddin (2018); and Yunitasari et al. (2019) explained that students consider pH calculations only use the concentration of H^+ ions from HCl and ignore the concentration of H^+ ions from H_2O (water). The possibility of this misconception is that students only focus on understanding the algorithm so that the H^+ concentration of the acid is substituted directly into the pH formula, namely pH = -log [H^+]. A pH value of 8 indicates that the solution is based but HCl is an acid solution so HCl solution (10^{-8} M) never exists and can also be neutral because the HCl has a low concentration causing H^+ ion does not to affect the ionization of water.

The Effect of Dual Situated Learning Model (DSLM)

Teachers do remedial teaching using DSLM after identifying diagnostic test results. Learning activities adapted to the syntax of DSLM and making Student Worksheets according to the concepts that cause misconceptions.

Table 3. DSLM steps on Acid-Base Materials

No	DSLM's syntax	Description
1	Examine the concept attributes and mental set lists needed to construct the concept.	The students analyze the concept of the base ionization constant (Kb) and then develop a mindset that students need to build to obtain a scientific understanding. The mental set that be built is:

<table>
<tr><th>No</th><th>DSLM's syntax</th><th>Description</th></tr>
<tr><td></td><td></td><td>1) The Kb value influenced the base strength. The smaller the Kb value, so the weaker the base strength
2) The pOH value shows the concentration of OH^- ions in the solution dan it's not a determinant of the base strength.</td></tr>
<tr><td>2</td><td>Investigate misconceptions about acid-base materials.</td><td>Identify the misconceptions experienced by students by applying the three-tier multiple choice that consists of 20 items using three levels. Following is an example of a TTMC question that is tested for students:
Look at the table below!
<table>
<tr><th>Base</th><th>pOH</th><th>K_b</th></tr>
<tr><td>NH_3 0,03 M</td><td>3,14</td><td>1,8 x 10^{-5}</td></tr>
<tr><td>N_2H_4 0,1 M</td><td>3,39</td><td>1,7 x 10^{-6}</td></tr>
<tr><td>$(CH_3)_2NH$ 0,002 M</td><td>2,98</td><td>5,4 x 10^{-4}</td></tr>
</table>
The correct order of strength of bases is….
Answer options:
A. N_2H_4 > $(CH_3)_2NH$ > NH_3
B. NH_3 > $(CH_3)_2NH$ > N_2H_4
C. N_2H_4 > NH_3 > $(CH_3)_2NH$
D. $(CH_3)_2NH$ > NH_3 > N_2H_4
Choice of reasons :
1. The pH value is directly proportional to the strength of the base. The higher the pH, the more alkaline the solution is
2. The Kb value indicates the ability of a base to ionize. The larger the value of Kb, the stronger the base
3. $(CH_3)_2NH$ has the lowest base strength because it has the largest Kb value so $(CH_3)_2NH$ cannot be ionized in water solvents
4. pOH indicates the concentration of OH^- ions in the solution. The higher the pOH, the more base
Are you certain:
A. Yes
B. No</td></tr>
<tr><td>3</td><td>Analyzing basic concepts that students still do not understand.</td><td>Provide information on what students' mental sets are weak or concepts that are misconceptions based on TTMC 1.</td></tr>
<tr><td>4</td><td>Arrange Dual Situated Learning Event (DSLE).</td><td>Step 1 (Student predictions)
Students are asked to predict the order of base strength of several alkaline solutions in tables A and B and how the relationship between Kb and the strength of the base is.
Table A
<table>
<tr><th>Base</th><th>pO H</th><th>pH</th><th>K_b</th></tr>
<tr><td>NH_3 0,03 M</td><td>…</td><td>…</td><td>1,8 x 10^{-5}</td></tr>
<tr><td>N_2H_4 0,1 M</td><td>…</td><td>…</td><td>1,7 x 10^{-6}</td></tr>
<tr><td>$(CH_3)_2NH$ 0,002 M</td><td>…</td><td>…</td><td>5,4 x 10^{-4}</td></tr>
</table>
Table B
<table>
<tr><th>Base</th><th>pOH</th><th>pH</th><th>K_b</th></tr>
<tr><td>NH_3 0,02 M</td><td>…</td><td>…</td><td>1,8 x 10^{-5}</td></tr>
<tr><td>N_2H_4 0,02 M</td><td>…</td><td>…</td><td>1,7 x 10^{-6}</td></tr>
<tr><td>$(CH_3)_2NH$ 0,02 M</td><td>…</td><td>…</td><td>5,4 x 10^{-4}</td></tr>
</table>
a) Rank the strength of the bases from smallest to largest!
b) Explain the relationship between Kb and the strength of the base!

Step 2 (reasoning)
Students give reasons for their predictions about the order of base strength.
Step 3 (confronting dissonance)
Ask students to calculate the pH and pOH of the two tables and compare the results of the calculations of the two tables</td></tr>
</table>

<table>
<tr><th>No</th><th>DSLM's syntax</th><th>Description</th></tr>
<tr><td></td><td></td><td>Step 4 (constructing a new mental set)
• Students are asked to rank the strength of bases based on pH and Kb
• Students are asked to explain the factors that affect the strength of a base
Students explain the relationship between the strength of the base and Kb.</td></tr>
<tr><td>5</td><td>Doing DSLE learning</td><td>Apply the DSLE model to students when learning using ppt and student worksheets</td></tr>
<tr><td>6</td><td>Challenge students with the Challenge Situated Learning Event (CSLE)</td><td>Step 1 (Student predictions)
Ask students to apply the new mental set by predicting the order of the acid strengths of the three acidic compounds below.
Look at the table below!
<table>
<tr><th>Acid solution</th><th>pH</th><th>Ka</th></tr>
<tr><td>HF 0,01 M</td><td>2,93</td><td>$7{,}2 \times 10^{-4}$</td></tr>
<tr><td>CH_3COOH 0,1 M</td><td>2,89</td><td>$1{,}8 \times 10^{-5}$</td></tr>
<tr><td>HNO_2 0,01 M</td><td>3,34</td><td>$5{,}1 \times 10^{-4}$</td></tr>
</table>
The order of acids strength from high to low is …
A. $HF > CH_3COOH > HNO_2$
B. $CH_3COOH > HF > HNO_2$
C. $HF > HNO_2 > CH_3COOH$
D. $HNO_2 > HF > CH_3COOH$
Step 2 (reasoning)
Students give reasons for answers in tier 1. For example:
1. The number of H^+ ions in solution affects the level of acidity. The lower the pH, the more acidic
2. pH affects the level of acidity. The lower the pH value, the more acidic it is
3. The greater the pKa, the more acidic.
4. The value of Ka affects the ionization of an acid solution. The bigger the Ka, the stronger the acid.
Are you certain:
A. Yes
B. No</td></tr>
</table>

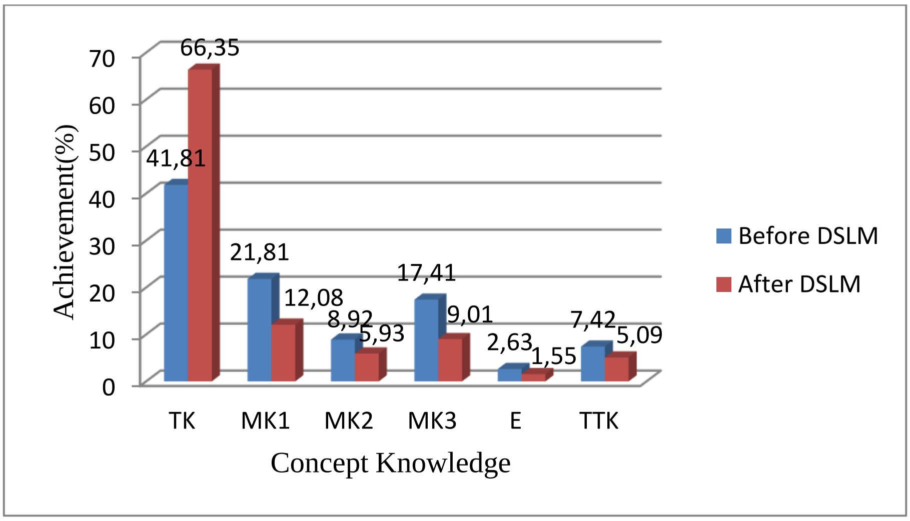


Figure 3. Percentage of Students' Overall Concept Understanding Before and After DSLM

Based on Figure 3. The number of students who understand the concept after learning DSLM is 66.35% or about 40 students who understand the concept of acid and base. Increased understanding of concepts followed by decreased misconceptions. Although this increase is only 24.54%, misconceptions descend from 48.14% to 27.02%, meaning the effectiveness of the decrease is 43.10%. The misconception of 27.02% including the low category. The percentage of low misconceptions is 1-30%, and 31-60% is moderate misconceptions (Anitasari, Winarti, & Rusmansyah, 2019). It proves that DSLM learning is quite effective in correcting and reducing misconceptions. The achievement of 40 students who understand the concept of acid-base as a whole shows that students are considered quite capable of applying the new mental set so that students can answer questions correctly and critically. This increase can be due to during the DSLM learning process, the students are allowed to discuss and express opinions on the concepts understood in solving each problem.

Research by Amry et al. (2017) reported that students who use conventional learning experienced many misconceptions compared to students who use DSLM learning. DSLM learning is better in providing opportunities for decreasing misconceptions than conventional's learning, which can be explained as follows:

First, the DSLM learning strategy is based on a constructivist view which explains that students learn to construct or learn their conceptual knowledge from interactions with their environment. Conventional learning is based on behavioristic philosophy which thinks that learning is a process of transferring knowledge from the teacher's mind to the students. This learning method rarely applies the initial concept activation strategy and prioritizes material and completion of basic competencies.

Second, one of the phases in DSLM is the provision of cognitive conflict which is the main point of changing concepts that are considered misconceptions into scientific concepts. Conflict occurs as a result of giving dissonance in the initial concept. This conflict phase is a way for students to want to understand and organize the wrong theory. At the end of the learning process, students have scientific knowledge. While conventional learning rarely uses the strategy of activating students' initial concepts. Students only receive information comes from the teacher without being allowed to find out the concepts being studied for themselves or students only as passive recipients of the information. This situation causes the process of learning activities in the classroom to be less than optimal. Therefore, DSLM learning is better in providing opportunities to change concepts or reduce misconceptions compared to conventional learning.

The first TTMC showed a high level of misconception of 48.14% or 29 students had difficulty understanding the truth. Researchers analyzed the results of TTMC, interviews, and observations during DSLM learning. The results of the identification of the causes of misconceptions are as follows:

1) Student condition

a) Wrong preconceptions
   Initial concepts that are different from scientific concepts can trigger misconceptions. This situation needs to be corrected if left unchecked will cause prolonged misconceptions and interfere with student learning outcomes. False preconceptions can be seen during the DSLM learning process so that teachers can improve the wrong concepts.

b) Wrong intuition
   During DSLM learning, students actively discuss and present the problems asked by the teacher. It encourages students to express their ideas related to the concepts they believe in. Students tend to use feelings in determining answers and reasons spontaneously so that they pay less attention to the reasons for the answers they express.

c) Incorrect reasoning.
   The choice of the wrong reason because mastery of concepts is not deep can cause students difficulty in giving answers that connect the first tier with the second tier. Sometimes students have chosen the correct answer to the first question but it is difficult to

choose a reason due to an incomplete understanding of the concept.

2) Teacher's condition

The learning process in acid-base applies a conventional model, namely direct learning. The teacher is more dominant in mastering learning than concerned with mastering students' concepts. The teacher does not give students the freedom to express the knowledge they understand because the acid-base material is complex and the learning time is limited. The teacher only emphasizes mastery of general concepts and only provides practice questions on the concept of calculation.

The finding of the cause of the misconception becomes a teacher's reference to apply the DSLM learning model as remedial teaching. During learning activities, the teacher gives dissonance to the students' early knowledge followed by a new mental set given through graphs, pictures, or explanations of how to answer counting questions. The results of the second TTMC test prove that DSLM learning can reduce the level of misconceptions from 48.14% to 27.02%. The effectiveness of reducing these misconceptions has not reached 50% and it is considered not running optimally due to the limited learning time. This learning only lasts for ± 90 minutes or a one-time meeting. The number of students who experience misconceptions and misconceptions is found in each item so the teacher needs to correct the understanding of the wrong concept. The limited teaching time resulted in a series of corrective actions for students' misconceptions about going fast and discussion activities being less than optimal.

DSLM learning done in two sessions are the first session is doing DSLE learning in the form of discussions and presentations, then the second session is doing CSLE in the form of challenges to apply the new mental sets that students have acquired. DSLE activities last ± 80 minutes and 10 minutes for CSLE. When the DSLE activity took place, students actively discussed and listened to some input on new concepts from the teacher. The inputs are then selected by students and related to the initial concept into correct knowledge. During the implementation of CSLE, the teacher gives TTMC questions according to the material and students can answer the questions. However, some students who speak for themselves and not paying attention to the teacher's explanation, so the application of the new mental set was only accepted by students who actually participated in the discussion. This problem interferes with the results of the second TTMC conducted by the researcher and proves that some students still have misconceptions about acid-base sub-materials.

DSLM learning will be successful in reducing misconceptions if there are additional time for remedial teaching at least two times a meeting. Because a one-time meeting is not enough to justify the concept that is a misconception, there needs to be another meeting so that the process of understanding the concept becomes deeper. The complexity of the material becomes an obstacle for researchers in carrying out remedial teaching if there is no additional time. If there is additional time, researchers can use it to find out more about concepts that are still wrong and correct the understanding of wrong concepts so that the application of the new mental set is easy to do.

CONCLUSION

Based on the results of the study, it was found that 29 students of class XI IPA at SMAN 1 Surakarta experienced acid-base.

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