Identification of Prospective Chemistry Teachers’ Misconceptions When Practicing Basic Teaching Skills and Their Correction Through Cognitive Conflict Strategies

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Abstract. Chemical misconceptions occur in almost all topics. Chemical misconceptions have been identified among students, students, and even teachers. Chemical concepts are interrelated, so misconceptions at the primary level have the potential to cause misconceptions in the next concept. This study aims to identify misconceptions held by prospective chemistry teachers practicing basic teaching skills and overcoming them through cognitive conflict strategies. This research is a naturalistic case study with an interpretive paradigm framework. Research is carried out naturally (natural setting) following the ongoing lecture program. The research was conducted during the even semester of the 2021/2022 academic year with 32 meetings for two classes. The research participants comprised 25 students (2 classes) taking microteaching courses. As the main instrument, the researcher is a microteaching subject with more than ten years of teaching experience. Data were collected using observation and interview methods with a cognitive conflict strategy framework. The results showed many misconceptions, including ionic bonds, ionization, and the formula for determining the pH of a buffer solution. Four prospective chemistry teachers experienced this misconception when practicing basic teaching skills. The correction results showed that 3 out of 4 students managed to correct the misconceptions that had been experienced before. One misconception is resistants. Based on the study results, it is recommended that a teacher or instructor pay attention to the misconceptions that occur and immediately overcome them as soon as possible.

Keywords: misconception; cognitive conflict strategy; chemistry

Introduction

Chemistry is a science that studies the properties, structure, and changes of matter down to the level of particles. Matter at the particle level includes atoms, ions, and molecules (Nakhleh, 1992). Atoms, molecules, and ions are objects of an abstract nature. Atoms, ions, and molecules cannot be observed with the five senses directly or with tools' help. Abstract concepts refer to traits arising from concrete concepts' interactions (Hayes & Kraemer, 2017). Thus, the science of chemistry generally studies abstract concepts in addition to concrete concepts.
Studying chemistry which generally contains abstract concepts, requires formal thinking skills. Not all chemistry students have achieved formal thinking skills (Winarni, 2019; Rezki et al., 2022). The low thinking ability of students in understanding the concepts of chemistry causes difficulties in understanding chemistry. Difficulties in studying chemistry can cause students to have a low understanding (Zakiyah et al., 2019) or even a wrong understanding. Consistent is characteristic of misconceptions. A misconception is the understanding of a person, in this case, a student, college student or even a teacher, who is different from the understanding of the scientific community. A misconception is the understanding of a person, in this case, a student, college student, or even a teacher, who is different from the scientific community's understanding (Nakhleh, 1992; Herron, 1996).

Chemical misconceptions at the basic level can continue in subsequent concepts. Incorrect chemistry concepts in the prerequisite material lead to misconceptions about related new concepts (Jusniar et al., 2020; Winarni & Syahrial, 2016). This relay misconception because the concepts in chemistry are interrelated and hierarchical. Based on the constructivist learning theory, students gain understanding by interpreting new information based on previous knowledge (Üce & Ceyhan, 2019). With the misconceptions they experience, students can apply concepts inappropriately, leading to wrong decision-making. Therefore, misconceptions need to be addressed. The first step in overcoming misconceptions is to identify them. Forms of overcoming misconceptions include identifying, subsequently eliminating/reducing, or even preventing them (Winarni et al., 2022).

Misconceptions in prospective teachers and teachers often occur. Some students taking the chemistry microteaching course have experienced misconceptions on several topics, including acid-base, electrolyte solutions, chemical bonds, reaction rates, and electron configurations (Winarni & Syahrial, 2022). Prospective chemistry teachers have experienced misconceptions about the concept of particulate matter (Rahmawati et al., 2019). Many prospective science teachers have experienced misconceptions about the concept of orbitals and the auto-ionization of water (Türk & Tüzün, 2018). Misconceptions about solution chemistry were experienced by many students who were prospective chemistry teachers (Imaduddin, 2018). Misconceptions of ionic bonds and covalent bonds are experienced by students who are prospective chemistry teachers (Pikoli, 2018). Misconceptions of covalent bonds are experienced by students who are prospective chemistry teachers (Erman, 2017). Chemistry teachers experienced misconceptions about covalent bonding by 52.3% (Muntholib et al., 2020).

Misconceptions in prospective teacher students need to be addressed as soon as possible. Misconceptions can be overcome in varied ways (Apriliani et al., 2022). Efforts to improve understanding of this concept can prevent misconceptions from occurring in the relay. Preventing misconceptions can be started by improving the understanding of wrong concepts experienced by prospective teacher students. Teaching the correct concepts according to scientists' understanding will change the misconceptions previously owned by students (Bayuni et al., 2018).

Good teaching activities planning can determine learning success (Mukarramah et al., 2021). One of the plans for overcoming misconceptions starts with choosing a learning strategy. Cognitive conflict is a common way of dealing with misconceptions. With cognitive conflict strategies, a person who experiences misconceptions is faced with facts or data of a contradictory nature. This contradictory data creates conflicts in thinking that can lead to a change in concepts (Hanson & Saky-Hagan, 2019). That is, the wrong understanding that has been held has changed the correct concept. The effectiveness of cognitive conflict strategies in overcoming misconceptions has been widely proven. Interviews based on cognitive conflict strategies reduce chemistry teacher misconceptions about covalent bond materials (Syahrial et al., 2023). Cognitive conflict strategies can reduce student misconceptions about material change (Labobar et al., 2017). Cognitive conflict strategies
effectively reduce the misconceptions about acid-base solutions experienced by students (Solang et al., 2021; Nazarudin & Sukarmin, 2017). Learning cycle-6e and cognitive conflict strategies can overcome misconceptions about acid-base (Jeharut et al., 2020). Strategies of cognitive conflict are significant in reducing chemical misconceptions experienced by prospective teachers (A’yun et al., 2017). The effectiveness of some learnings in reducing misconceptions is caused by the conditioning of cognitive conflicts (Islamiyah et al., 2022). Cognitive conflict strategies successfully reduce misconceptions of reaction rates (Nurmartarina & Novita, 2021).

Every student who will practice basic teaching skills has prepared learning tools for presenting chemical materials. Thus, the material/understanding presented in learning by prospective teacher students practicing basic teaching skills is an understanding that is believed to be correct. So, an understanding that is different from the understanding of the scientific community presented by students of prospective chemistry teachers during teaching practice can be expressed as misconceptions. Therefore, this study aims to identify misconceptions that occur in students of prospective chemistry teachers when practicing basic teaching skills and correct them with cognitive conflict strategies.

**Method**

This research is a naturalistic case study with an interpretive paradigm framework. The research was carried out naturally (natural setting) following the ongoing lecture program. This study aims to describe the misconceptions experienced by final-year chemistry students who are taking microteaching courses. Microteaching lectures are carried out naturally based on the semester lecture design (SLD) and even semester lecture contracts for the 2021/2022 academic year.

A total of 25 chemistry education students taking microteaching courses are research participants. There were 25 participants divided into two classes. All students have graduated from some compulsory basic courses such as general chemistry I, general chemistry II, stoichiometry, teaching-learning strategy, learning plan, high school textbook study X, high school textbook study XI, high school textbook study XII, and solution chemistry.

The research has been conducted for 1 semester (even) of the 2021/2022 school year. Students are observed to perform while practicing basic teaching skills for 16 meetings in each class. So, the number of meetings for the two classes was 32 meetings. Each student has the opportunity to appear to teach at least 4 times.

This research is a case study within the framework of qualitative methods, with the researcher as the main instrument. The first researcher has 10 years of teaching experience in the field of chemistry education studies and has experience as a lecturer in microteaching courses, chemistry textbook studies class X, XI, XII, and stoichiometry. The second researcher has teaching experience in chemistry education for > 20 years and is experienced as a lecturer in microteaching, basic chemistry i, ii, and basic chemistry practicum courses. The first researcher attended 32 learning meetings for two classes. The first and second researchers conducted a content analysis of the observation results and interviews. The first researcher has 10 years of teaching experience in the field of chemistry education studies and has experience as a lecturer in microteaching courses, chemistry textbook studies class X, XI, XII, and stoichiometry. The second researcher has teaching experience in chemistry education for > 20 years and is experienced as a lecturer in microteaching, basic chemistry i, ii, and basic chemistry practicum courses. The first researcher attended 32 learning meetings for two classes. The first and second researchers conducted a content analysis of the observation results and interviews.
All students who participated were observed while practicing basic chemistry teaching skills. The stages in practicing teaching include (1) opening and closing lessons; (2) explaining the learning material; (3) integrating skills; and (4) teaching skills by experimental methods. Researchers wrote down every mistake explained by students, including those categorized as misconceptions. Not all concept explanation errors fall under misconceptions (Winarni, 2015).

Reflection is carried out after each student has practiced teaching practice. In this reflection activity, interviews were conducted to correct previously identified misconceptions. Interviews are conducted until validation of the concept is achieved. Concept validation is carried out to ensure a change in the concept from misconception to the scientific concept. In the final stage of this study, students who experienced misconceptions carried out re-practice as a remedial activity with a delay time of 1-2 weeks.

Data were collected through observation and interview techniques. For the identification of misconceptions is carried out by information techniques and ascertained at the beginning of the interview. Correction of misconceptions through cognitive conflict strategies conducted at the time of the interview. Interviews are one way to determine a person's understanding (Wibowo & Amelia, 2021). Research in the interpretive paradigm framework analyzes qualitative data, among others, through content analysis (Ozturk & Aglarci, 2017).

Results and Discussion

Of the 25 students who practiced teaching, 4 experienced misconceptions, as shown in Table 1.

<table>
<thead>
<tr>
<th>Students Who Experience Misconceptions</th>
<th>Concept</th>
<th>Misconceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL</td>
<td>Ion bonding</td>
<td>An ionic bond is a bond that occurs between metal and nonmetallic atoms</td>
</tr>
<tr>
<td>OL</td>
<td>Buffer Solution</td>
<td>Determination of pH in the buffer solution by writing the formula for the concentration of H⁺ ions as follows: $[\text{H}^+] = \frac{[\text{weak acid}]}{[\text{salt}]}$ ... (1)</td>
</tr>
<tr>
<td>NB</td>
<td>Ionization</td>
<td>Electrolyte Solution is a solution whose solute undergoes ionization</td>
</tr>
<tr>
<td>SY</td>
<td>Ionization</td>
<td>NaCl table salt will undergo ionization in the solvent</td>
</tr>
</tbody>
</table>

Based on Table 1, it is known that 4 out of 25 students experienced chemical misconceptions about ion bonding, buffer solutions, and ionization. 75% of misconceptions are statements of knowledge or propositions, and 25% are formulas.
Misconception 1. An ionic bond is a bond that occurs between metal and nonmetallic atoms.

The understanding that an ionic bond is a bond between a metal atom and a nonmetallic atom is a misconception. Students generally experience misconceptions about chemical bonds on the concept of ionic bonds (Khandagale & Shinde, 2021). NaCl is an ionic compound because it is formed from metal atoms, and nonmetallic atoms are classified as a misconception (Yasthophi & Ritonga, 2018; Prodjosantoso et al., 2019). Not all bonds between atoms and nonmetallic atoms include ionic bonds. For example, the bond in BeCl₂ occurs between the metal atom Be and the nonmetallic atom Cl but does not include the ionic bond. The Be atom has an electronegativity value of 1.5, while the Cl atom has an electronegativity value of 3.0. The difference in electronegativity between the Be and Cl atoms < 1.7 is based on the Pauling scale, so it cannot be grouped in ionic bonds.

Ionic bonds can occur in compounds formed from metal atoms with nonmetals if the difference in electronegativity is greater than 1.7 on the Pauling scale (Effendy, 2016). For example, NaCl, MgCl₂, and KCl are ionic compounds with ionic bonds between metal and nonmetallic atoms. The correct understanding is that an ionic bond is an attraction/electrostatic force between cations and anions whose electronegativity differences differ significantly (IUPAC, 2014).

The strategy to avoid misconceptions about ionic bonds is to teach ionic bonds, starting with the concept and the types of ions (Effendy, 2016). Thus students will understand several things, including:

1. Not all bonds that occur between metal atoms and nonmetallic atoms are ionic bonding. Examples of BeCl₂ include covalent compounds.
2. Ionic bonds can occur in compounds whose constituent elements do not contain metal atoms. For example, NH₄Cl includes ionic compounds.
3. Ionic bonds can occur between polyatomic cations and polyatomic anions. For example, NH₄NO₃,
4. The difference in the price of electronegativity between bonded atoms is one of the indicators in determining the type of bond between metal and nonmetallic atoms, especially for the biner compound.

Misconception 2. pH in solution buffer with the formula of the concentration of H⁺ ions like equation 1.

Abstract concepts use symbols or formulas to teach problem-solving (Zhang, 2017). Symbols and formulas are used to determine the magnitude of the concentration of H⁺ ions. Determining the concentration of H⁺ ions is written as a formula to be stored in long-term memory. However, if it is incorrect in writing the formula as in equation (1), it can be problematic because the error is stored in long-term memory. Misconceptions relating to the determination of pH or the determination of [H⁺] weak acid solutions have been reported by Widarti et al. (2017). It was found that some students experienced a weak understanding of determining concentration [H⁺] (Suteno et al., 2021). Misconceptions such as equation 1, is the determination of [H⁺] in acid buffer solutions derived from excess weak acids and strong bases with a valence of two has an equally large ratio of weak acid concentrations and conjugate bases. Misconceptions such as equation 1, the determination of [H⁺] in acid buffer solutions derived from excess weak acids and strong bases with a valence of two, has an equally large ratio of weak acid concentrations and conjugate bases (Ulva et al., 2016).

Misconception 2 states that the concentration of conjugated bases equals the concentration of their salts. This understanding can be derived from the formula for determining the pH in the buffer solution, especially the formula for the concentration of H⁺ ions of the acid buffer solution, which is written incorrectly, like the formula [H⁺] in equation 1. It is known that the concentration of conjugated bases is not always equal to the concentration of their salts, or the concentration of conjugated acids is not always equal.
to the concentration of their salts in determining the pH of the buffer solution. This understanding is because not all conjugated bases are derived from salts with an anion index of one, such as CH₃COONa. Some conjugated bases are derived from salts with an anion index of more than one, that is, (CH₃COO)₂Ca. For salts that have an anion index of 2, then how to determine the concentration of the conjugation base of the acid buffer solution component with the component CH₃COOH /CH₃COO⁻ is as follows:

\[(\text{CH}_3\text{COO})_2\text{Ca} \rightarrow 2\text{CH}_3\text{COO}^- + \text{Ca}^{2+} \quad (2)\]

Based on equation 2, in one solution, the concentration of salt (CH₃COO)₂Ca is not equal to that of CH₃COO⁻. The concentration of conjugated bases as one of the components of the acid buffer, CH₃COO⁻, is equal to twice the concentration (CH₃COO)₂Ca. So, equation (2) proves that equation (1) contains misconceptions. The exact formula for determining the concentration of H⁺ ions in the acid buffer solution is written as follows:

\[
\left[\text{H}^+\right] = \frac{\text{[weak acid]}}{\text{[conjugate base]}} \quad \text{(3)}
\]

Misconceptions 3. A solution electrolyte is a solution whose solute undergoes ionization and misconception 4. NaCl table salt will undergo ionization in a water solvent

Students of prospective chemistry teachers who experienced misconceptions 3 and 4 above that NaCl decomposed in water were ionized. The correct understanding is that NaCl undergoes dissociation in water. Misconceptions about ionization have also been reported by Winarni & Syahrial (2022), who found that students of prospective chemistry teachers understand that every substance that decomposes into free ions in water means undergoing ionization. Students cannot distinguish between ionization and dissociation because they understand NaCl, including ionic compounds ionized in water into Na⁺ and Cl⁻ ions (Yasthophi & Ritonga, 2018).

The decomposition of substances in water into ions can occur due to ionization and dissociation. Examples of substances subjected to ionization or dissociation are shown in Table 2.

<table>
<thead>
<tr>
<th>The process of decomposition of substances</th>
<th>Ionization</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCl in water becomes H⁺ ions, and Cl⁻ ion</td>
<td>Ionization</td>
<td>HCl is an example of a molecule. The H atom and the Cl atom in HCl bind covalently.</td>
</tr>
<tr>
<td>HBr in water becomes H⁺ ions, and Br⁻ ion</td>
<td>Ionization</td>
<td>HBr is an example of a molecule. H atoms and Br atoms in HBr bind covalently.</td>
</tr>
<tr>
<td>NaCl in water becomes Na⁺ and Cl⁻ ions</td>
<td>Dissociation</td>
<td>NaCl is an ionic compound.</td>
</tr>
<tr>
<td>NaOH in water decomposes into OH⁻ and H⁺ ions</td>
<td>Dissociation</td>
<td>NaOH is an ionic compound</td>
</tr>
<tr>
<td>H₂O decomposes into OH⁻ and H⁺ ions</td>
<td></td>
<td>H₂O is an example of a covalent compound.</td>
</tr>
</tbody>
</table>
The process of decomposition of substances | Ionization/ Dissociation | Information
---|---|---
PCl₅ becomes PCl₃ and Cl₂ | Dissociation | PCl₅, PCl₃, and Cl₂ of molecules whose atoms all bind covalently.

**Correction misconception through cognitive conflict strategy**

Every student who experiences misconceptions is treated during reflection activities after they appear to practice their teaching skills. Each student follows the cognitive conflict strategy to change misconceptions, as shown in Figure 1.

![Figure 1](image)

**Figure 1** Main steps of cognitive conflict strategy (Effendy, 2002)

Conditioning cognitive conflicts by presenting/conveying contradictory data or understanding or examples. Cognitive conflict strategies are applied during reflection activities after each student appears to practice teaching skills. The followed an excerpt from an interview conducted on students who experienced misconceptions during reflection activities after peer-teaching. Instructors conducted interviews with prospective chemistry teacher students who experienced misconceptions according to the steps of cognitive conflict strategies, according to Figure 1.
Correction to misconception 1. experienced by NL

Instructor: "Good students, we have been listening to NL's practice of teaching skills." OK, NL, I noted your explanation that an ionic bond is a bond between a metal atom and a nonmetallic atom. "Is that right?"

NL: "Right, Mom."

Instructor: "Well, what about the bond on BeCl₂?"

NL: "Silent, thinking"

Instructor: "Beryllium atoms belong to metal or nonmetallic atoms?"

NL: "Silent, thinking"

Instructor: "What group are the Be atoms in the Periodic System of Elements?"

NL: "Group IIA Mom."

Instructor: "Does it mean that the Be atom is classified as a metal or nonmetallic atom?"

NL: "Be is a Metal atom."

Instructor: "Bonding that occurs in BeCl₂, metal bonds or covalent bonds?"

NL: "Silent, thinking."

Instructor: "OK, NL, please remember the molecular form discussion, BeCl₂. Does BeCl₂ mean it belongs to ionic molecules or compounds?"

NL: "Molecule"

Instructor: "Does it mean that the bond between Be and two of Cl atoms includes a covalent or ionic bond?"

NL: "Covalent bond."

Instructor: "Back to the explanation that an ionic bond is a bond between a metal and a nonmetallic atom. Is this true or not?"

NL: "Yes, Mom, the understanding is not right."

Instructor: "So what is the right understanding."

NL: "The bond between metal and nonmetallic atoms is not always an ionic bond."

Based on the interview, several things can be taken using the above cognitive conflict strategies. First, the identified misconception is that an ionic bond is a bond that always occurs between metal and nonmetallic atoms. Second, the fact presented to condition cognitive conflict is BeCl₂, a molecule with covalent bonds where Be is a metal atom and Cl is a nonmetallic atom. BeCl₂ is a covalent compound (Effendy, 2017). Third, some questions aid the occurrence of equilibration, such as the BeCl₂ molecule's appearance. Fourth, the reconstruction of understanding that the bond between metal and nonmetal atoms is not always ionic. Cognitive conflict strategies have been appropriately implemented, and misconceptions successfully corrected. This conclusion can be seen in the final part, students of prospective chemistry teachers succeed in building the right understanding. The new concept that is constructed is plausible to indicate a change in concept (Posner et al., 1982)

Correction to misconception 2. experienced by OL

Instructor: "Good students, just now, we listened to the integrated teaching practice by OL. OK, OL, I have noted that based on your explanation, the concentration of H⁺ ion is determined first with the following formula to determine the pH of a buffer solution with acid type. Is this correct the equation has been written by

\[
[H^+] = \frac{[\text{weak acid}]}{[\text{salt}]}
\]

OL: "yes, Mom, right."

Instructor: "For example, there is an acid buffer solution with a salt of CH₃COONa, the buffer solution component mean anything?"

OL: "The weak acid CH₃COOH and its conjugated base are CH₃COO⁻"
Instructor: "Yes, right. "How to determine the concentration of its conjugation base?"
OL : "Equal to the salt concentration, mom."
Instructor: "Well, that is right. Now if the acid buffer has a conjugated base derived from salt (CH₃COO)₂Ca, how to determine the concentration of the conjugation base?"
OL : "equal to its salt concentration, Mom."
Instructor: "Try to write down the reaction equation showing the decomposition of the salt (CH₃COO)₂Ca."
OL : " (while being guided by the instructor)."
Instructor: "If the reaction equation is as written, how is the concentration of conjugation bases? Is it the same as the salt concentration?"
OL : (seemingly thinking) "Not the same, Mom,"
Instructor: "So, is the formula for determining the concentration of H⁺ ions in the pH determination that has been written down while teaching earlier?"
OL : "Yes, wrong, Mom."
Instructor: "How is the right one? Remember how to determine the formula of the H⁺ ion, return to the basic concept of the buffer solution specifically concerning its components."
OL : "The truth means something like this

\[ [H^+] = \frac{[\text{weak acid}]}{[\text{conjugate base}] \times K_a} \]

Instructor: "Yes, that's right"

Based on interviews between instructors and students who experience misconceptions (OL) using the cognitive conflict strategy above, several things can be stated, including: (1) the misconceptions identified are related to the formula for determining the concentration of H⁺ ions, namely equating salt concentrations with conjugated base concentrations of weak acids; (2) the facts presented to condition cognitive conflict are salt (CH₃COO)₂Ca; (3) some questions as an aid to the occurrence of equilibration that is what are the constituent components of the acid buffer solution?; whether it is always the same concentration of salt with the concentration of its conjugated base in an acid buffer solution; and (4) reconstruction of understanding that is by conveying the correct formula for the concentration of H⁺ ions. Cognitive conflict strategies have been appropriately implemented, and misconceptions about the H⁺ ion formula for determining pH have successfully undergone a change of concept toward a correct understanding of the concept. Symbols or formulas are generally used for abstract concepts to teach algorithmic and contextual understanding (Zhang, 2017).

**Correction to misconception 3. experienced by NB**

Instructor: "Ok, students, we have just listened to the integrated teaching practice on behalf of NB. OK NB, I have noted that an explanation has been presented: Electrolyte Solution is a solution whose solute undergoes ionization in the solvent. Is Right?"
NB : "Right, Mom."
Instructor: "Ok. This statement is appropriate for the HCl solution. What about a NaCl solution? Does NaCl solution include electrolyte solution?"
NB : "Yes, the NaCl solution includes a strong electrolyte solution."
Instructor: "NaCl includes ionic compounds or covalent compounds?"
NB : " Ionic compounds."
Instructor: "If NaCl is an ionic compound, if it decomposes in water into freer Na\(^+\) and Cl\(^-\) ions in a NaCl solution, can it be called NaCl in a solvent undergoing ionization?

NB: Silent, thinking

Instructor: "From the beginning, NaCl was in the form of ions, and in water, it remained an ion only more freely. Is this appropriate if it is referred to as ionization"

NB: "Means to have dissociation, Mom."

Instructor: "Yes, this is what Mom meant. Back to your explanation at the beginning, how is it true?"

NB: "An electrolyte solution is a solution in which the solute undergoes ionization or dissociation in a water solvent."

Instructor: "Yes, right."

Based on interviews between instructors and students who experience misconceptions (NB) using cognitive conflict strategies, that can be stated in the following ways. First, the identified misconception is that an electrolyte solution is a solution whose solute undergoes ionization in a solvent. Misconceptions related to ionization have been experienced by students of prospective chemistry teachers (Winarni & Syahrial, 2022).

Second, the fact presented to condition cognitive conflict is that NaCl is an electrolyte solution where NaCl as a solute decomposes in water. Third, some questions as an aid to the occurrence of equilibration that is whether the NaCl solution includes an electrolyte solution; does NaCl include ionic compound? whether ionic compounds that decompose in water become freer ions? and the statement leads "from originally NaCl was ions and in water remained ions, only more freely. Fourth, reconstruction of the understanding that an electrolyte solution is a solution in which the solute undergoes ionization or dissociation in a water solvent. The cognitive conflict strategy has been appropriately implemented, the misconception about ionization in the electrolyte solution was successfully corrected, and the student managed to build a correct understanding.

**Correction to misconception 4. experienced by SY**

Instructor: "Good students, we have just listened to the integrated teaching practice on behalf of SY. OK, SY, earlier, I noted that an explanation had been presented: NaCl table salt will undergo ionization in water solvents. Right, huh?"

SY: "Right, Mom"

Instructor: "NaCl includes ionic compounds or covalent compounds?"

SY: "Ionic compounds, Mom."

Instructor: "If NaCl is an ionic compound if it decomposes in water into freer Na\(^+\) and Cl\(^-\) ions in a NaCl solution, can it be called NaCl in a solvent undergoing ionization?"

SY: Silent thinking

Instructor: "It means that from the beginning, NaCl was in the form of ions and water. It remained an ion only more freely. Is this appropriate if it is referred to as ionization"

SY: "Means NaCl in a water solvent undergoes bu dissociation."

Instructor: "Yes. That is the right one. Back to your explanation at the beginning, how is the correct statement?"

SY: "NaCl table salt will undergo dissociation in a water solvent."

Instructor: "Yes, the statement is correct."

Based on the interview, several things can be taken using the above cognitive conflict strategies. First, the identified misconception is that NaCl table salt will undergo ionization in the water solvent. NaCl in water undergoes dissociation instead of ionization. Secondly, the fact that is presented to condition cognitive conflicts is that NaCl is an ionic
compound. Third, some questions to aid the occurrence of equilibration are whether NaCl before and after being dissolved in water remains as ions can be expressed as an ionization process. Fourth, reconstruction of the understanding that NaCl table salt will undergo dissociation in water solvents. The cognitive conflict strategy has been appropriately implemented, and the misconception about ionization in salt decomposition in the formation of electrolyte solutions is successfully corrected. This conclusion suggests that conditioning of cognitive conflicts has been appropriately created. The conditioning stage of cognitive conflict determines the success of some learning strategies in reducing misconceptions (Islamiyah et al., 2022).

**Misconceptions that are resistant even though corrected through cognitive conflict strategies**

After a misconception is overcome with a cognitive conflict strategy, one misconception occurs repeatedly. Misconceptions in the form of a pH determination formula were again presented by one student prospective chemistry teacher when practising teaching in the last cycle. Based on the observation of 4 students who repeated teaching practices because they were identified with misconceptions, 1 person still conveyed previously identified misconceptions. The repetition of misconceptions after going through the elimination of misconceptions indicates the presence of resistant properties. A resistant misconception is a formula for determining the concentration of H⁺ ions: the value of Ka multiplied by the concentration of weak acids per salt concentration. After being asked, the source of the formula comes from learning resources on the internet. In addition to being experienced by students, misconceptions can also be present in teaching materials such as textbooks (Ivanoska & Stojanovska, 2021; Meltafina et al., 2019). Excerpts from textbooks have been widely poured on the internet, such as in individual blog articles where there is no certainty about their validity.

Winarni & Syahrial (2022) report that misconceptions originating from social media and written in a structured manner are resistant. This statement means that although misconceptions have been overcome until there is a change in concept, after some time, misconceptions occur again repeatedly. This recurring misconception indicates that misconceptions are stored in long-term memory in the owner's mind. The misconceptions derived from teaching materials have very high resistance properties. Therefore, teaching materials free of misconceptions are needed, especially for students who have just learned about chemistry (Winarni, 2010).

**Conclusion**

Misconceptions are experienced by students of prospective chemistry teachers when practicing basic teaching skills related to the concepts of ionic bonding, ionization, and determination of the concentration of H⁺ ions in buffer solutions. Misconceptions that can be eliminated through cognitive conflict strategies are 3 out of 4 misconceptions. Misconceptions sourced from formulas are resistant. The existence of resistant misconceptions indicates the need to prevent them before they occur.
References


