

---

## The Mnemonic Correction Becomes Meaningful Through Focus Group Discussion in Chemistry Learning

*Sri Winarni<sup>1\*</sup> and Syahrial<sup>1</sup>*

*<sup>1</sup>Department of Chemistry Education, Faculty of Teacher Training and Education, Universitas Syiah Kuala, Banda Aceh, Indonesia*

*\*E-mail: [sriwinarni@unsyiah.ac.id](mailto:sriwinarni@unsyiah.ac.id)*

Received: 4 October 2022; Accepted: 24 November 2022; Published: 31 December 2022

---

### Abstract

One of the concerns in the learning process is the meaning of writing mnemonics to help students memorize chemistry concepts. The research aimed to correct mnemonics in learning presentation by prospective chemistry teachers' students to be meaningful. The research used constructive design and qualitative methods. The researcher was the main instrument for the microteaching course. Data were collected through observation, focus group discussions (FGD) based on cognitive conflict, and documentation analysis. The results showed that it was found that two prospective chemistry teachers' students from different groups presented the same mnemonic with less meaningful. The mnemonic was used to memorize the halogens (group 17 of the periodic table). The less meaningful mnemonic generally comes from social media. Based on the group discussion, the students of prospective chemistry teachers obtained 18 mnemonics with meaningful values. Prospective teachers must be able to improve mnemonics in learning to make it more meaningful, one way being to integrate ethnoscience aspects. It was suggested that there should promote creativity in developing learning that encourages positive attitudes to strengthen character education.

Keywords: focus group discussion (FGD), meaningful, microteaching, mnemonic

---

DOI : <https://doi.org/10.15575/jtk.v7i2.19139>

### 1. Introduction

Chemistry consists of abstract concepts that are interrelated and complex. The concepts in chemistry are built from simple to complex to form a hierarchy. Besides, chemistry studies matter in terms of structure, properties, changes, and the energy that accompanies these changes. The material studied in chemistry is up to the particle level. Also, matter at the particle level includes atoms, ions, and molecules. Abstract chemistry concepts are easier to understand for students with formal thinking skills. Factually, not all students who are studying chemistry can think formally (Winarni, 2019). In making the chemistry lesson easier to understand, chemical concepts are presented in macroscopic, submicroscopic, and symbolic representations.

Macroscopic representation is an image that presents a concept or phenomenon that can be sensed (Russell et al., 1997). Macroscopic representations are presented so students can build connections between the concepts studied and the natural phenomena used to deal with their weaknesses in understanding the chemistry concept. Submicroscopic representations are images of objects or phenomena involving chemicals at the particle level that cannot be sensed directly or with the help of tools such as a microscope. Symbolic representations are symbols that represent an object or event (Santos & Arroio, 2016).

Complex chemical concepts are taught with various models, strategies, methods, and techniques according to the conditions of the learning environment. One of the learning techniques used to study chemistry is

mnemonics. The word mnemonic comes from the Greek word "mnēmonikos," meaning memory or relating to memory (Jurowski et al., 2015). A mnemonic is not only an acronym abbreviation but can be an imaginary picture, a poem/rhyme, a story, or a recording of the first letter (Bellezza, 1981; Higbee, 1985). Therefore, mnemonics can be used in all subjects or all fields of knowledge.

From a pedagogic point of view, mnemonics can be viewed as a tool/device (Bellezza, 1981), a strategy (Mastropieri et al., 2005; Tullis & Qiu, 2021), a method (Iza & Gil, 1995; Jurowski et al., 2014; Ögüt et al., 2022), or technique (Dunlosky et al., 2013; Stagg & Donkin, 2016; Bala et al., 2021). Although educational experts have different views about mnemonics, the purpose of their use is to train and strengthen the memory of a fact.

Mnemonics are often called the donkey bridge, so connecting facts or concepts with things already familiar to students is easy. The bridge between the concept and the names of familiar objects is an attempt to make a connection. The more connections related to the concept, the more meaningful and easy learning is stored in long-term memory. One way learning content can be stored in long-term memory is to make many connections between concepts (Winarni, 2016). Therefore, mnemonics must be related to prior knowledge (Mastropieri et al., 2005).

Connections between concepts, knowledge, and understandings in chemistry learning should consider values. For a reason, the chemistry concepts are all related to human life. The matter at the particle level is closely related to activities in everyday life (Ozmen, 2010). Some examples of the role of chemistry in life are as follows. In the health sector, chemistry has an important role, for example, in determining the concentration of a substance/drug for patients with a specific body weight, determining compounds that can absorb toxic substances in food poisoning sufferers, and determining levels of anesthetic that are safe for patients. In agriculture, chemistry plays an important role, for example, in determining soil acidity levels to

determine suitable plants and determining fertilizer levels for a certain amount of land. In the food industry, chemistry plays an important role, for example, in determining how to preserve food that is safe for consumption.

The essential role of chemistry in human life makes chemistry inseparable from values. Value is one of the contents of chemistry. Meanwhile, several subject matters in general for each science include (1) facts; (2) concepts; (3) principles; (4) problems; (5) skills; and (6) values (Fathoni & Riyana, 2011). Therefore, teachers must teach and write appropriate values in chemistry learning (Herron, 1996). The appropriate value is one of the teacher's considerations in designing chemistry lessons (Winarni et al., 2022). Values are ideas, concepts, or understandings believed to be accurate and useful for social life based on religion and prevailing norms. Besides, values can be in the form of behavior or actions called character. Value is a point of view in solving life problems based on an understanding of chemistry (Winarni & Syahrial, 2020).

Furthermore, the 2013 Indonesian Education National Curriculum emphasizes the importance of developing students' positive character in learning. Strengthening character education in learning planning according to the 2013 curriculum with five main elements: religion, nationalism, independence, cooperation, and integrity based on the demands of 21st-century learning (Mukarramah et al., 2021). Mnemonics can make the meaning of learning stored in long-term memory, so it is very profitable if the presentation has appropriate values. On the other hand, it would be detrimental if the mnemonic presentation has less meaningful value because it will also be stored in long-term memory. For this reason, the last stage of the mnemonic technique is to repeat until students are declared to understand (Ardika, 2016). Therefore, the presentation and selection of mnemonics need to pay attention to values and character.

A chemistry teacher must address learning that indicates a less meaningful presentation

of understanding. One strategy that can be applied to correct presentations that contain less meaningful values is Focus Group Discussion (FGD). FGD is a qualitative data collection technique to reveal a phenomenon. FGD can reveal the causes of misconceptions that students experience when practicing basic teaching skills (Winarni & Syahrrial, 2022).

Several studies on the integration of positive values which form the basis of student character development have been carried out. Besides, some positive characteristics have been successfully integrated into chemistry learning, such as: gratitude; honesty; discipline; cooperation; creativity; care for the environment; and responsibility (Seliwati, 2021). The highest student character is gratitude to *Allah swt* (The Creator), successfully integrated into chemical questions on hydrocarbon and petroleum materials (Sulastri et al., 2018). In addition, several 21st-century skill values, such as: never give up; thrifty; careful; tolerance; critical and innovative thinking, is one among the goals in textbooks for 5th-grade elementary school students published by the Ministry of Education and Culture of the Republic of Indonesia 2017 (Widodo et al., 2019). Other research also shows that religious values integrated into the chemical handout on salt hydrolysis topic received positive responses from teachers and students with excellent criteria (Nira et al., 2021). In addition to the values above, in learning it is important to instill meaning in the words used, one of which is for mnemonics. There are still limited researches to overcome the less meaningful mnemonics in chemistry learning.

## 2. Research Method

### 2.1. Research Design

This research uses constructive/naturalistic design and qualitative methods (Kristiansen et al., 2017). This research was conducted in a natural setting to describe events in final-year chemistry students taking a microteaching course. Besides, this study was conducted based on the Lecture Plan and Lecture Contract of the even semester for the 2021/2022 academic year.

### 2.2. Research Subject

The subjects of this research consisted of two parallel classes taking microteaching courses. Subjects as many as 25 students of prospective chemistry teachers are willing to work as research informants.

### 2.3. Research Time

This research was conducted for one semester in the even semester of the 2020/2021 academic year. All students' performance was observed when practicing basic teaching skills for 16 meetings (January – May 2022). The FGD was held shortly after the students demonstrated their basic teaching skills

### 2.4. Research Instrument

This research is based on a qualitative method with the researcher as the main instrument. The researcher has experience as a teacher of microteaching courses. The first researcher was directly present in 16 learning meetings.

The researcher wrote down all the phenomena that arose when the participants practiced their basic teaching skills. Next, the researcher conducted interviews in the FGD with participants who used mnemonics with less meaningful values. During the FGD, the researcher asked several questions to ensure that the mnemonic used had been prepared. The questions asked are intended to correct mnemonics that contain less meaningful values. After that, the first and second researchers analyzed the results of observations, interviews (FGD), and documentation.

### 2.5. Research Procedure

The researcher observed 25 students of prospective chemistry teachers practicing basic teaching skills. The basic skills of teaching chemistry consist of four stages: skills to open and close lessons; skills in explaining the subject matter; integrated chemistry teaching skills; and chemistry teaching skills with experimental methods. Therefore, each student had the opportunity to appear at least four times. Two students who presented a mnemonic with less meaningful value had a remedial chance to teach practice again. Participants were free to determine the topic

of the material to be delivered. When students did teaching practice, the researcher wrote down all the observations as material for discussion during the FGD, including, in this case, a mnemonic with less meaningful value.

After students had practiced basic teaching skills, the FGD was immediately conducted to find out why and what sources of mnemonics contained less meaningful values. After all, students realized the wrong importance of the mnemonic; then, the researcher asked all students to compose a mnemonic with meaningful values.

## 2.6. Data Analysis

Qualitative data analysis based on content analysis is an interpretive paradigm framework (Ozturk & Aglarci, 2017). The analysis was carried out on documentation, such as lesson plans, scenarios, presentation slides, and interview excerpts. Direct observation was carried out when practicing basic teaching skills. Besides, the FGD involved all participants and was carried out shortly after each student had finished practicing basic teaching skills.

Inductive data analysis had also been carried out to find the meaning of the mnemonics displayed by the participants. Moreover, the researchers discussed the meaning of terms in the mnemonic one by one before finally finding the importance of the mnemonic with less meaningful values in chemistry learning.

## 2.7. Data Collection

The researchers used observation techniques, interviews, and documentation to collect the data. Meanwhile, the interviews were not conducted separately but classically in the form of FGDs but were shown after observing the practice of teaching skills. If there were indications that students conveyed learning with less meaningful values, a cognitive conflict-based FGD was undertaken immediately.

## 2.8. Data Triangulation

Data was collected based on observations, FGDs, documentation, and confirmation from research subjects who presented mnemonics

with less meaningful values. The validation aims to reduce the researcher's subjectivity as the main instrument. This data triangulation serves as a test of the validity of the research data needed for qualitative research (Siswati et al., 2018).

## 3. Result and Discussion

### 3.1. Chemical Mnemonics with Less Meaningful Values

Based on the results of observations, it was found that two prospective chemistry teacher students presented mnemonics with less meaningful values coming from different learning classes. The mnemonics presented by the two students are shown in Table 1.

**Table 1. Chemical Mnemonics with Less Meaningful Values**

Mnemonic	
Imaginative words	Elements as target concept
<i>Fanta</i>	F - Fluorine
<i>Cola</i>	Cl - Chlorine
<i>Bir</i>	Br - Bromine
<i>Idaman</i>	I - Iodine
<i>Ati</i>	At - Astatine

To convince students that the mnemonic presented above has less meaningful value, an FGD is conducted. This FGD was paralleled by other students who showed the same mnemonic. Table 2 is an excerpt from the conversation during the FGD.

The interview was conducted to condition the conflict in students' minds that Fanta, Cola, and Bir are not drinks that students can crave. Based on the interview excerpt above, it is known that less meaningful mnemonics come from social media on the internet. Without thinking about it, student prospective teachers immediately present it in learning. This wrong mnemonic presentation occurs because there needs to be a filter for students selecting information from content providers, which generally have no guarantee of validity. Everyone has a vast opportunity to upload content on the internet; not all students know this.

Table 2. Excerpt of Conversation During FGD

Teacher	Students
All right, students, especially those practicing basic teaching skills. Earlier, a learning technique was shown to make it easier for students to memorize the 17 group elements. Is that right?	Yes, that's right, Ma'am.
Is there something missing from the learning technique earlier?	(all students were quiet and looked confused)
All right, A (the name of the student who presents less meaningful mnemonic) and all students. You know <i>Fanta</i> and <i>Cola</i> , right?	Yes, both are carbonated drinks, Ma'am.
Is it good to consume these drinks in terms of health?	It's not good, Ma'am, if it's too much.
Yes. That is, as much as possible, we should avoid consuming it, except only occasionally. Is this drink suitable if it is called <i>Idaman Ati</i> ? ( <i>Idaman Ati</i> means what the heart desires).	No, Ma'am.
Well. How about <i>Bir</i> ? Do you know what <i>Bir</i> is? ( <i>Bir</i> means beer).	Alcoholic drink, Ma'am.
Is it good to drink it?	No, Ma'am.
Alcoholic drinks can be intoxicating, cause loss of consciousness, and even death. Our religion (Islam) strictly prohibits this. So why did you use that as a mnemonic?	The goal is to make it easier for them to remember, ma'am. I didn't notice. It is sourced from YouTube.
Words have power. The mnemonic should also be meaningful, not have less meaningful value.	Okay, Ma'am.
To overcome this less meaningful mnemonic, please, each student, thinks of a mnemonic for the same topic but with meaningful value.	Okay, Ma'am.

On the other hand, using "*Bir Idaman Ati*" as a mnemonic strengthens the group 17 memory of the elements Br, I, and At. Consequently, the teacher agrees that beer can be consumed because it is coupled with the words "*Idaman Ati*", which means something that pleases the heart. The meaning of these words can have a negative influence on students' thinking that beer is a normal thing to like.

Mnemonics are not just to strengthen memory but must pay attention to the value contained in it. This material is since learning chemistry needs to consider value (Herron, 1996; Winarni et al., 2022). Thus, the primary learning objectives of chemistry will be achieved. Hence, it contributes to solving life's problems.

### 3.1.1. Mnemonic of "*Fanta, Cola, Bir Idaman Ati*"

According to the Indonesian Dictionary, "*idaman*" means something desired/expected (Badan Pusat Pengembangan dan Pembinaan Bahasa, 2016). If in the context of food or drink, then desire can be interpreted as food or drink that craved. Therefore, juxtaposing the word with the names of objects or brands

such as *Fanta*, *Cola*, or *Bir* confirms the desire or pleasure for these objects.

*Fanta* and *Cola* are soft drink brands containing carbonated water (CO<sub>2</sub> in water). The carbonation reaction is a reaction between water and CO<sub>2</sub> gas which will produce H<sub>2</sub>CO<sub>3</sub> which makes this carbonated drink acidic. Carbonated drinks are a health problem if consumed with high frequency. Carbonated drinks, whose impressive sales figures, can reduce bone density and cause osteoporosis (Berawi & Dzulfiqar, 2017; Chen et al., 2020; Kremer et al., 2019). Moreover, *Fanta* and *Cola* can potentially increase obesity and class two diabetes because it belongs to carbonated drinks (Mutaqin, 2018). Heo and Wylie-Rosett's (2020) research showed a relationship between obesity in high school students and intake of carbonated drinks. Also, Lin et al. (2021) reported that 50% of the sample showed indications of hyperuricemia for young and middle age people who drank excessively carbonated drinks.

On the other hand, *Bir* (beer) is a fermented beverage and is technically a liquor produced mainly from malt but includes other

carbohydrate sources (Baxter & Hughes, 2001). Many experts argue that beer is the oldest drink produced by biotechnology processes that have been known since 6000 years in Mesopotamia and the ancient Egyptians knew beer as an intoxicating drink around 3000 years before Christ (Hampson, 2008). By this time, beer was being produced almost all over the world, except in Islamic countries.

As a result of carbohydrate fermentation, beer contains ethanol in varying degrees, from 0.5 to 67.5%. Beer with a high ethanol content is known as extreme beer (Hampson, 2008), and non-alcoholic beer, according to the FDA's CPG Sec 510.400, is allowed to contain a maximum of 0.5% ethanol (Food and Drug Administration, 2005). Factually, no beer is free of ethanol because it will change the taste, so even if there is, carbon dioxide must be added to the beer (Shoemaker, 2019). Based on the history of the discovery of beer, even though it is known that free alcohol is available, it is still assumed to be liquor or alcoholic beverages in the human mind.

Besides, alcoholic beverages produced by fermentation containing  $\geq 0.5\%$  are forbidden/prohibited in Islam. This condition follows the fatwa of the Indonesian Ulema Council No. 10 of 2018 on the third dictum number 2, which reads, "fermented beverage products containing more than 0.5% alcohol are illegal/forbidden". On the same page, it is also explained in the legal provisions of the Indonesian Ulema Council fatwa concerning food and beverage products containing alcohol/ethanol in part C No. 3, which reads: "Use of non-*khamr* industrial alcohol/ethanol (both the result of chemical synthesis) [from petrochemicals] or non-*khamr* fermentation industry products) for beverage product ingredients, the law is: permissible, if it is medically harmless and as long as the alcohol/ethanol ( $C_2H_5OH$ ) content in the final product is less than 0.5%". One of the legal bases is surah *Al-Baqarah* verse 219 concerning gambling intoxicants, and in Christianity, intoxicating drinks or containing alcohol (ethanol) are also prohibited, as stated in *Proverbs* 20 verse 1. Therefore, alcoholic or

intoxicating drinks such as beer are not justified for consumption.

Based on its content, beer is a drink that can be intoxicating and is included in the *khamr*/intoxicants category in Islam. The consumption of alcoholic beverages (ethanol) will lead to tolerance (increasing the level of alcohol concentration) and dependence (Tritama, 2015). Another effect of consuming alcoholic beverages is causing osteoporosis (Berawi & Dzulfiqar, 2017). Drinks containing ethanol will diffuse in the bloodstream from the stomach accelerated by soft drinks, and if the concentration of ethanol in the blood is 3.5 g/L or 3.5 g for every 1 L of blood, it can cause death (Effendy, 2017). Other researchers report that alcoholic drinkers have a high risk of developing head and neck cancer (Di Credico et al., 2020). Minzer et al. (2020) reported that consuming alcohol has the potential to have a heart attack. Probst et al. (2020) reviewed several research reports regarding the consequences of alcohol consumption and found that 30,000 out of 400,000 adult drinkers died. If the percentage is calculated, 7.5% of drunks die from alcohol.

After reviewing several effects of consuming carbonated and alcoholic beverages, everyone cannot make *Fanta*, *Cola*, or *Bir* an *idaman* drink. In terms of health and religious aspects, none of them supports making these three drinks worthy of being used as icons for drinks, especially in activities related to education and teaching. This condition follows the goals of national education for all levels, and one of them is to make students become human beings who believe in God Almighty and are healthy.

### **3.2. Ethnoscience-Loaded Mnemonic Recommendations for Group 17 Elements by the Course Teacher**

The mnemonic for substituting (*Fanta-Cola-Bir-Idaman-Ati*) for atoms F, Cl, Br, I, At (group 17) was developed by 19 students participating in microteaching. The teacher had previously exemplified it. The mnemonic with a positive value (there is a positive meaning in everyday life, especially in Aceh)

which the teacher compiled as an example shown in Table 3.

**Table 3. Ethnoscience-Loaded Mnemonic Recommendations by the Teacher**

Mnemonic	
Imaginative words	Elements as target concept
<i>Fonna</i>	F - Fluorine
<i>Clan</i>	Cl - Chlorine
<i>Briena</i>	Br - Bromine
<i>Idaman</i>	I - Iodine
<i>Ati</i>	At - Astatine

*Fonna-Clan-Briena-Idaman-Ati* means *Fonna* in a group/collaborating with *Briena* to be the heart desire of her parents. *Phonna* is the name of the first child; *Phonna* means already exists (in Acehese). *Briena* is the short name of the second child of *Geubriena*, which means already given (in Acehese).

Chemistry learning related to local language or culture shows ethnoscience content

(Imansari et al., 2018). The mnemonic presentation is ethnoscience to make learning objectives more meaningful based on Ausubel's learning theory. This ethnoscience-based mnemonic presentation can be integrated into appropriate learning models. Thus, chemical terms extracted from everyday language will make students more familiar with learning them, which is one characteristic of the constructivist learning component (Laszlo, 2013).

### 3.3. Mnemonic of Group 17 Elements by Students of Chemistry Prospective Teacher

After the teacher gave an example of a mnemonic with good value, students were asked to construct a mnemonic for the same case. Table 4 shows mnemonics composed by chemistry education students taking microteaching courses.

**Table 4. Chemical Mnemonics Composed by Students**

Mnemonics of group 17 with meaningful values	The value contained in the mnemonic
<i>Fasti-Calau-Belajar-Ingat-Allah ta'ala</i>	If someone would like to do something, especially studying, everyone must remember or intend because <i>Allah swt</i> , because all of us will be blessed and pleased by <i>Allah</i> .
<i>Film-Charles-Bronson-Idola-Atiku</i>	If a person remembers or memorizes, remember things close to life, for example, the movie the people like.
<i>Fans-Club-Barcelona-Ingin-Atraksi</i>	Something that makes someone love learning and dare to face their own choices
<i>Fera-Clara-Baru-Ikut-Athletik</i>	The meaning is close to everyday life, such as participating in sports activities that can nourish the body, examples of athletics include running, jumping, walking, and throwing)
<i>Fitrah-Celuarga-Berencana-Islami-Amat tinggi</i>	A Muslim must do everything based on religion/Islam because everything will be blessed and will always make a Muslim calm and always on the right path (to be on the path of <i>Allah swt</i> )
<i>Fatimah-Celalu-Beribadah-Ingat-dunia Akhirat</i>	By worshipping, someone can draw closer to <i>Allah</i> , and provide a sense of security, peace, and calm because <i>Allah</i> takes care of every matter of his/her servants. <i>Allah</i> will pleasure His servants because <i>Allah</i> will guide each of his/her servants to the path of goodness.
<i>Fatia-Clara-Bermain-dl-lAut</i>	Apart from learning in the classroom, someone can also make the environment of everyday life a place and source of learning.
<i>Fitri-Clan-Brand-Idaman-Atiku</i>	-
<i>Film-Charles-Bronson-Idola-Atiku</i>	-
<i>Fans-Club-Barcelona-Ingin-Atraksi</i>	-
<i>Faridah-Calon-Baru-Istri-Ateng</i>	-
<i>Flora-Clara-Barusan-Ikut-Asti</i>	-
<i>Fara-Clara-Bara-Ingin-Atraksi</i>	-

Mnemonics of group 17 with meaningful values	The value contained in the mnemonic
<i>Fanta-cocaCola-Brokoli-Idaman-Ati</i>	-
<i>Ftv-Channel-Baru-Idaman-Ati</i>	-
<i>Festival-Celana-Baru-Itu-Antik</i>	-
<i>Fuji-Color-Baru-Idola-Atik</i>	-
<i>Festival-Clean-Bersama-Idaman-Ati</i>	If the Cleanliness Festival is carried out together, there will be peace in the heart (heart's desire)
<i>Fandi-Celuarga-Berencana-Islami-Amat tinggi</i>	-

Consequently, out of 25 students, 19 completed the mnemonic requested by the teacher/subject teacher. In addition, students wrote eight of 19 mnemonics with their meanings. Based on the 19 mnemonics compiled by students, there were 18 meaningful mnemonics. The correction result of 95% showed the effectiveness of cognitive conflict-based FGDs in changing mnemonics with less meaningful values into mnemonics with positive meanings to be presented in chemistry learning.

One mnemonic compiled still mentions *Fanta Cola* as *idaman ati*. During the FGD, it was discussed that the drinks were also not healthy drinks because of their harmful effects. It can be understood that errors originating from social media or the internet are difficult to fix, even though they have been corrected. This phenomenon also follows the research results, which state that conceptual errors originating from the social media are resistant or repetitive even though improvements have been made (Winarni & Syahrial, 2022).

#### 4. Conclusion

Each student of the prospective chemistry teacher was asked to compose a mnemonic for group 17 elements to avoid using mnemonics with less meaningful values. There were 18 meaningful mnemonics of 19 mnemonics compiled by students (95%). FGD effectively eliminates less meaningful mnemonics. Hence, students of prospective chemistry teachers need to be equipped with the skills to filter learning presentations with less meaningful values.

#### References

- Ardika, Y. (2016). Efektivitas metode mnemonik ditinjau dari daya ingat dan hasil belajar matematika siswa kelas X TPA SMKN 2 Depok Sleman. *Kreano, Jurnal Matematika Kreatif-Inovatif*, 7(1), 66–73. <https://doi.org/10.15294/kreano.v7i1.5006>
- Badan Pusat Pengembangan dan Pembinaan Bahasa. (2016). *Kamus Besar Bahasa Indonesia*. Retrieved from <https://kbbi.kemdikbud.go.id>
- Bala, K., Butter, A., Sahib, S. M., & Kishor, N. (2021). Effect of mnemonic techniques on anxiety of students in science at senior secondary level. *Wutan Huatan Jisuan Jishu*, 17(6). <https://doi.org/10.37896/whjj17.6/712>
- Baxter, E. D., & Hughes, P. S. (2001). *Beer: Quality, safety and nutritional aspects*. The Royal Society of Chemistry.
- Bellezza, F. S. (1981). Mnemonic devices: Classification, characteristics, and criteria. *Review of Educational Research*, 51(2), 247–275. <https://doi.org/10.3102/00346543051002247>
- Berawi, K. N. D, & Dzulfiqar. (2017). Konsumsi soft drink dan efeknya terhadap peningkatan risiko terjadinya osteoporosis. *Majority*, 6(2), 21–25. Retrieved from <https://juku.kedokteran.unila.ac.id/index.php/majority/article/view/1007>



- Chen, L., Liu, R., Zhao, Y., & Shi, Z. (2020). High consumption of soft drinks is associated with an increased risk of fracture: A 7-year follow-up study. *Nutrients, 12*(2), 530. <https://doi.org/10.3390%2Fnu12020530>
- Di Credico, G., Polesel, J., Dal Maso, L., Pauli, F., Torelli, N., Luce, D., Radoi, L., Matsuo, K., Serraino, D., Brennan, P., Holcatova, I., Ahrens, W., Lagiou, P., Canova, C., Richiardi, L., Healy, C. M., Kjaerheim, K., Conway, D. I., Macfarlane, G. J., ... Edefonti, V. (2020). Alcohol drinking and head and neck cancer risk: The joint effect of intensity and duration. *British Journal of Cancer, 123*(9), 1456–1463. <https://doi.org/10.1038/s41416-020-01031-z>
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest, Supplement, 14*(1), 4–58. <https://doi.org/10.1177/1529100612453266>
- Effendy. (2017). *Ilmu kimia untuk siswa SMA dan MA kelas XI* (1st ed.). Malang: Indonesian Academic Publishing.
- Fathoni, T., & Riyana, C. (2011). Komponen-komponen pembelajaran. In Tim Pengembang MKDP (Eds.), *Kurikulum dan Pembelajaran* (pp. 147–177). Jakarta: Rajawali Pers.
- Food and Drug Administration. (2005, November 29). *CPG Sec 510.400 Dealcoholized wine and malt beverages - Labeling*. Retrieved from <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/cpg-sec-510400-dealcoholized-wine-and-malt-beverages-labeling>
- Hampson, T. (2008). *The beer book*. New York: DK Publishing.
- Heo, M., & Wylie-Rosett, J. (2020). Being obese versus trying to lose weight: Relationship with physical inactivity and soda drinking among high school students. *Journal of School Health, 90*(4), 301–305. <https://doi.org/10.1111/josh.12879>
- Herron, J. D. (1996). *The chemistry classroom formula for successful teaching*. American Chemical Society.
- Higbee, K. L. (1985). Cross-cultural applications of Yōdai mnemonics in education. *Educational Psychologist, 20*(2), 57–64. [https://doi.org/10.1207/s15326985ep2002\\_1](https://doi.org/10.1207/s15326985ep2002_1)
- Imansari, M., Sudarmin, & Sumarni, W. (2018). Analisis literasi kimia peserta didik melalui pembelajaran inkuiri terbimbing bermuatan etnosains. *Jurnal Inovasi Pendidikan Kimia, 12*(2), 2201–2211. Retrieved from <https://journal.unnes.ac.id/nju/index.php/JIPK/article/view/15480>
- Iza, N., & Gil, M. (1995). A mnemonic method for assigning the electronic configurations of atoms. *Journal of Chemical Education, 72*(11), 1025–1026. <https://doi.org/10.1021/ed072p1025>
- Jurowski, K., Jurowska, A., & Krzeczowska, M. (2015). Comprehensive review of mnemonic devices and their applications: State of the art. *International E-Journal of Science, Medicine and Education, 9*(3), 4–9. <https://doi.org/10.56026/imu.9.3.4>
- Jurowski, K., Jurowska, A., Krzeczowska, M., & Własiuk, P. (2014). Mnemonic methods as a sophisticated tool in learning the science subjects from Polish pupils point of view. *Edukacja Humanistyczna, 2*(2), 72–85. Retrieved from <https://depot.ceon.pl/handle/123456789/9075>

- Kremer, P. A., Laughlin, G. A., Shadyab, A. H., Crandall, C. J., Masaki, K., Orchard, T., & Lacroix, A. Z. (2019). Association between soft drink consumption and osteoporotic fractures among postmenopausal women: The Women's Health Initiative. *Menopause*, *26*(11), 1234–1241. <https://doi.org/10.1097/GME.0000000000001389>
- Kristiansen, L., Lif, U., & Asklund, H. (2017). Experiences on participation in literary activities: Intellectual stimuli empower people with mental health problems. *Open Journal of Nursing*, *07*(11), 1307–1323. <https://doi.org/10.4236/ojn.2017.711094>
- Laszlo, P. (2013). Towards teaching chemistry as a language. *Science and Education*, *22*(7), 1669–1706. <https://doi.org/10.1007/s11191-011-9408-6>
- Lin, W. T., Kao, Y. H., Lin, H. Y., Li, M. S., Luo, T., Fritz, J. M., Seal, D. W., Lee, C. H., Hu, C. Y., & Tseng, T. S. (2021). Age difference in the combined effect of soda drinks consumption and body adiposity on hyperuricaemia in US adults. *Public Health Nutrition*, *24*(17), 5756–5768. <https://doi.org/10.1017/S1368980021000513>
- Mastropieri, M. A., Scruggs, T. E., Graetz, J., Fontana, J., Cole, V., & Gersen, A. (2005). Mnemonic strategies: What are they? How can i use them? And how effective are they? *Insights on Learning Disabilities*, *2*(1), 1–17. Retrieved from <https://www.semanticscholar.org/paper/Mnemonic-Strategies%3A-What-Are-They-How-Can-I-Use-Mastropieri-Scruggs/837f1e2d1f5846550539d6f089d55a75a7f626ab>
- Minzer, S., Losno, R. A., & Casas, R. (2020). The effect of alcohol on cardiovascular risk factors: Is there new information? *Nutrients*, *12*(4), 1–22. <https://doi.org/10.3390/nu12040912>
- Mukarramah, M., Gani, A., & Winarni, S. (2021). Analisis kesesuaian perangkat pelaksanaan pembelajaran dengan tuntutan pembelajaran abad 21. *Jurnal IPA & Pembelajaran IPA*, *5*(3), 233–241. <https://doi.org/10.24815/jipi.v5i3.21934>
- Mutaqin, Z. Z. (2018). Dinamika aspek kesehatan dan ekonomi dalam kebijakan pengendalian minuman berkarbonasi di Indonesia. *Quality: Jurnal Kesehatan*, *1*(1), 26–37. Retrieved from <https://ejournal.poltekkesjakarta1.ac.id/index.php/adm/article/view/27>
- Nira, Sulastri, & Winarni, S. (2021). Handout hidrolisis garam bermuatan nilai religi. *Jurnal Pencerahan*, *15*(1), 17–28. Retrieved from <https://jurnalpencerahan.org/index.php/jp/article/view/48>
- Ögüt, S., Sönmezkale, İ., & Işıktaş, S. (2022). Examination of teachers opinions on the importance of mnemonic strategies. *The Online Journal of New Horizons in Education*, *12*(1), 36–47. Retrieved from <https://www.tojned.net/journals/tojned/articles/v12i01/v12i01-05.pdf>
- Ozmen, H. (2010). Turkish primary students' conceptions about the particulate nature of matter. *International Journal of Environment & Science Education*, *6*(1), 99–121. Retrieved from <https://files.eric.ed.gov/fulltext/EJ930287.pdf>
- Ozturk, O. F., & Aglarci, O. (2017). Prospective chemistry and science teachers' views and metaphors about chemistry and chemical studies. *Egitim Arastirmalari - Eurasian Journal of Educational Research*, *2017*(71), 119–139. <https://doi.org/10.14689/ejer.2017.71.7>
- Probst, C., Kilian, C., Sanchez, S., Lange, S., & Rehm, J. (2020). The role of alcohol use and drinking patterns in socioeconomic

- inequalities in mortality: a systematic review. *The Lancet Public Health*, 5(6), e324–e332.  
[https://doi.org/10.1016/S2468-2667\(20\)30052-9](https://doi.org/10.1016/S2468-2667(20)30052-9)
- Russell, J. W., Kozma, R. B., Jones, T., Wykoff, J., Marx, N., & Davis, J. (1997). Use of simultaneous-synchronized macroscopic, microscopic, and symbolic representations to enhance the teaching and learning of chemical concepts. *Journal of Chemical Education*, 74(3), 330. <https://doi.org/10.1021/ed074p330>
- Santos, V. C., & Arroio, A. (2016). The representational levels: Influences and contributions to research in chemical education. *Journal of Turkish Science Education*, 13(1), 3-18. Retrieved from <https://www.tused.org/index.php/tused/article/view/632>
- Seliwati. (2021). Integrasi pendidikan karakter dalam pembelajaran kimia materi minyak bumi pada siswa kelas XI MIPA SMA Negeri 5 Palangka Raya. *Jurnal Ilmiah Kanderang Tingang*, 12(1), 86–101.  
<https://doi.org/10.37304/jikt.v12i1.120>
- Shoemaker, S. (2019, November 5). *Everything you need to know about non-alcoholic beer*. Heathline. Retrieved from <https://www.healthline.com/nutrition/non-alcoholic-beer#alcohol-content>
- Siswati, Utomo, C. B., & Muntholib, A. (2018). Implementasi pendidikan karakter dalam membentuk sikap dan perilaku sosial peserta didik melalui pembelajaran sejarah di SMA PGRI 1 Pati tahun pelajaran 2017/2018. *Indonesian Journal of History Education*, 6(1), 1–13. Retrieved from <https://journal.unnes.ac.id/sju/index.php/ijhe/article/view/27332>
- Stagg, B. C., & Donkin, M. E. (2016). *Mnemonics* are an effective tool for adult beginners learning plant identification. *Journal of Biological Education*, 50(1), 24–40.  
<https://doi.org/10.1080/00219266.2014.1000360>
- Sulastri, S., Rusman, R., & Arifa, A. (2018). Pengembangan soal-soal kimia bermuatan nilai-nilai untuk memperkokoh karakter Siswa SMA. *Jurnal Tadris Kimiya*, 3(2), 171–181.  
<https://doi.org/10.15575/jtk.v3i2.3512>
- Tritama, T. K. (2015). Konsumsi alkohol dan pengaruhnya terhadap kesehatan. *Journal Majority*, 4(8), 7–10. Retrieved from <https://juka.kedokteran.unila.ac.id/index.php/majority/article/view/1465>
- Tullis, J. G., & Qiu, J. (2021). Generating *mnemonics* boosts recall of chemistry information. *Journal of Experimental Psychology: Applied*.  
<https://doi.org/10.1037/xap0000350>
- Widodo, A., Indraswati, D., & Sobri, M. (2019). Analisis nilai-nilai kecakapan abad 21 dalam buku siswa SD/MI kelas V Sub Tema 1 Manusia dan Lingkungan. *Tarbiyah: Jurnal Ilmiah Kependidikan*, 8(2), 125.  
<https://doi.org/10.18592/tarbiyah.v8i2.3231>
- Winarni, S. (2016, November). *Pembelajaran yang membangun pemahaman kimia bersifat long-term memory*. Paper presented at the Seminar Nasional Kimia dan Pembelajarannya "Riset Unggulan Kimia dan Pembelajarannya Sebagai Integritas dan Daya Saing Bangsa", 105–112.
- Winarni, S. (2019). *Keefektifan concept approval strategy dalam mencegah miskonsepsi materi sifat koligatif larutan* [Universitas Negeri Malang]. Retrieved from <http://repository.um.ac.id/id/eprint/115627>
- Winarni, S., & Syahrial. (2020). Memperkaya sudut pandang siswa dalam penyelesaian masalah kehidupan

melalui pembelajaran kimia.  
*Paedagogia*, 23(1), 1–11.  
<https://doi.org/10.20961/paedagogia.v23i2.52236>

<https://doi.org/10.22201/fq.18708404e.2022.2.79841>

Winarni, S., Effendy, E., Budiasih, E., & Wonorahardjo, S. (2022). Constructing 'concept approval strategy,' a chemistry learning idea to prevent misconceptions. *Educación Química*, 33(2), 159–180.

Winarni, S., & Syahrial, S. (2022). Revealing chemical misconceptions through the microteaching process in the era of the Covid-19 pandemic. *Jurnal Kimia dan Pendidikan Kimia*, 7(1), 50–63. <https://doi.org/10.20961/jkpk.v7i1.55587>