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Implementation of Learning Plans Sharing and Jumping Tasks on Nominating Material for Inorganic Chemical Compounds to Grow Critical Thinking Skills

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Abstract

This research aims to design and implement sharing and jumping task learning on inorganic compound nomenclature material to foster critical thinking skills. The applied didactical design research (Didactical Design Research) consists of 3 stages, namely: Didactical situation analysis before learning in the form of hypothetical didactical design including Didactical Pedagogical Anticipation (ADP), Metapedadidactical Analysis, and Retrospective Analysis after learning. The research subjects were 28 class X high school students. The research results found that: (1) The sharing and jumping task learning design on the nomenclature of inorganic compounds is quite effective in developing students' critical thinking skills. (2) Based on transcript analysis, most students can develop critical thinking skills, especially asking and answering clarifying/challenging questions. However, students have difficulty developing critical thinking skills in making and assessing valuable assessments. The sharing and jumping task learning design developed can be used as an alternative design in the nomenclature of inorganic compounds.

Keywords: didactical design (DDR), learning design, sharing and jumping tasks, critical thinking skills

INTRODUCTION

The 21st century is the century of knowledge, where information is widely spread and technology is developing. The abundance of information available anywhere and accessible at any time is a characteristic of the 21st century (R&D, 2013). The demands of the 21st century are students' abilities and skills including critical thinking, problem-solving, creativity, innovation, able to communicate and collaborate (Wijaya, Y., Sudjimat, D., & Nyoto, 2016). One of the skills that is very necessary in this era of globalization is critical thinking. In line with what was said by (Femiceyanti et al., 2019) critical thinking skills are one part of 21st-century innovation learning skills that enable students to handle future problems.

Critical thinking is part of scientific thinking because it is based on logic, clarity, and relevance (Rosyana et al., 2019). Through critical thinking, students can reason, understand and make complex decisions, understand the relationships between systems, and analyze and solve problems (Gazali & Dasna, 2023). Therefore, it is important to teach critical thinking skills in schools to equip students to think at a higher level so that they are useful in decision-making. Correspondingly (Siti Nuraeni et al., 2019) say someone who thinks critically is a person who is able and tends to believe and act according to his reasoning.

According to Ennis (Costa, 1991), Critical thinking skills are the process of building reasons or arguments to decide what to believe and do. This (Zoller, 1999) states that critical thinking is the ability to be results-oriented, rational, logical, think reflectively about beliefs, and then make decisions and be responsible for the decisions that have been taken. Learning to think critically guides students to develop other skills, such as a high level of concentration, the ability to analyze, and in-depth thought processes (Redhana, 2015).

However, in reality, in the world of education, learning in schools is still teacher-centered and does not maximize student involvement in learning activities. According to Sumarno (Zainal, 2014). One of the factors causing the ineffectiveness of science learning is that the learning process in Indonesia is still largely teacher-centered (Istiana, GA, Agung, NC, 2015).

Chemistry and critical thinking are two things that cannot be separated, chemistry contains complex concepts (Siti Nuraeni et al., 2019). However, some students still tend to find chemistry subjects difficult to learn. According to (Yusfiani, 2006), the difficulty of studying chemistry is because most of the chemistry is abstract, chemistry is a simplification of most objects that exist in this world, it is a mixture of complex and

complicated substances, chemistry is not just about solving problems consisting of numbers (numerical problems) which is an important part of studying chemistry.

One of the topics in chemistry is the subject of the nomenclature of compounds which requires more memorization. Nevertheless, However, the concept of compound nomenclature is still considered a difficult topic for teachers to teach and students to learn. This is in line with(Herlina, Heliawati, L., & Permana, 2019)stated that students who did not memorize the names of elements/ions had difficulty remembering the names of polyatomic compounds and were unable to differentiate between metal and non-metal elements.

Liliasari (Liliasari, 2002)States that the greatest difficulty in mastering the material is on the topic of the nomenclature of inorganic compounds. The results of his research showed that students' reasoning patterns did not develop too much.

Sharing and jumping task learning is not only able to improve cognitive abilities but also trains students' psychomotor and affective aspects and is not only used for students with high cognitive abilities but also benefits students with low cognitive abilities. (Jones, P. & Hammon, 2016). In line with(Fatimah, I., Hendayana, S., & Supriatna, 2018) the sharing task stage can facilitate collaboration between students, while the jumping task stage can facilitate students with high academic abilities to think at a higher or critical level. According to(Sato, 2013), the problem given in the jumping task section, namely applicative material from basic concepts taken from basic material that has been developed (exceeds textbook level).

Based on the description of the background of the problem, the research question is "How is the implementation of sharing and jumping task learning on inorganic compound nomenclature material to foster critical thinking skills?

METHOD

The research uses qualitative descriptive methods. This method was chosen because the researcher wanted to describe the details of an event in a particular situation and produce descriptive data in the form of written or spoken words from the subjects being observed.

The research design used in this research is Didactical Design Research (DDR). This design was chosen because researchers wanted to design and implement learning. DDR has 3 (three) stages, namely prospective analysis, metapedadidactic analysis, and retrospective analysis (Suryadi, 2013).

Critical thinking skills are analyzed based on qualitative descriptive data obtained from observations during the learning process which are recorded via audio and video using the Transcript Based Lesson Analysis (TBLA) method.

Participants

Participants in this research were 28 high school students in class X MIA.5. In this research, the learning design was created and implemented by researchers.

Research Instrument

The type of instrument used in this research is a non-test instrument. The non-test instruments used were interview guides, observation sheets, student worksheets, and documentation. Instrument content validation was carried out by two chemistry lecturers and one chemistry teacher.

Observation

Observations of the learning process regarding the implementation of the sharing and jumping task learning design were made by the researcher and implemented by the researcher himself. Observers in this research are one chemistry teacher and four people who are lesson study members.

Interview

The type of interview in this research is a semi-structural interview which aims to explore in-depth information from the research subjects. Interviews were conducted with teachers in the field of chemistry based on an interview guide sheet. Teacher interviews were conducted to find out the models, strategies, and methods commonly used in teaching as well as the difficulties experienced by students when taking part in learning, especially on the nomenclature of inorganic compounds. The results of teacher interviews were used as a reference in designing sharing and jumping task learning on the nomenclature of inorganic compounds to foster critical thinking skills in high school students.

Documentation

The documentation in this research is in the form of documents that teachers use in learning, such as lesson plans and teaching materials regarding the nomenclature of inorganic compounds. Documentation

studies were carried out before implementing the sharing and jumping task learning design, namely during personalization and recontextualization.

Student Worksheets (LKS)

Student worksheets (LKS) are used as a data collection tool to determine the quality of student's answers from the results of their critical thinking regarding shared tasks and jumping tasks. The questions contained in this assignment are critical "How" questions. Sharing task 1, namely, how to create nomenclature rules for binary ion compounds. Students are given formula data for a group of ionic compounds along with their names, students are asked to observe and create nomenclature rules from the results of these observations. Sharing task 2, how to make nomenclature rules for binary covalent compounds, and sharing task 3, how to make nomenclature rules for polyatomic compounds. Jumping task, students find the formula and name of chemical compounds on the market. Before implementation or use, the LKS and learning design are first validated by two expert lecturers.

Data analysis technique

Activities in data analysis include data reduction (organizing data), data display (making detailed descriptions), and conclusion drawing/verification (interpreting and concluding).

Table 1. Critical Thinking Skills Rubric

Critical Thinking Skills Indicator	Sub Indicator	Score	
		0	1
Focusing questions	Formulate questions		
	Identify/formulate answer criteria		
Analyze arguments	Identify conclusions		
	Identify the stated reasons		
	See similarities and differences		
	Identify & address irrelevance		
Ask & answer clarifying/challenging questions	The “Why” question?		
	“How” Questions		
	What does it mean?		
	What is not an example?		
	What are the facts?		
	Is this what you said?		
Assessing the credibility of a source	Disadvantages/problems/advantages		
	Ability to give reasons		
Observe & assess observation reports	Reports from observers, not other people		
	Minimal conclusions are involved		
Deduction & assessing deductions	Interpretation of statements; logical words "only", "or", "same", "not" neither.		
Induction & assessing induction	General Statement		
	Concluding explanations & hypotheses		
Create & assess valuable judgments	Background facts		
	Consequences/consequences		
	Acceptable applications/principles		
	Consider alternatives		
Explain symbols/formulas & assess definitions/dimensions	Classification/grouping		
	Example/non-example		
	Reporting a meaning		
	Determine meaning		
	Pay attention to the context		
Identify assumptions	Reason not stated		
	Requires assumptions		
Deciding on a course of action	Defining the problem		
	Select criteria to assess possible solutions		
	Decide on alternative solutions		
	Decide what to do		
Interact with other people	Affirm consequences		
	Deny		
	Starting questions		
	Obscurity		
	Argument from analogy		
	Logical strategy		
	Presentation		

Information:

0 = does not appear

1 = appears

RESULTS AND DISCUSSION

In this chapter, the findings and discussion related to the research that has been presented are presented, namely, describing the form of learning design, implementation, and profile of critical thinking skills that emerged during the implementation of sharing and jumping task learning on the nomenclature of inorganic compounds.

Initial activity

Before learning begins, the teacher asks the student's attention to the future and the teacher reminds them about the concept that the students had previously acquired, namely the concept of the periodic system of elements (SPU). The complete activity can be seen in Figure 1 below.

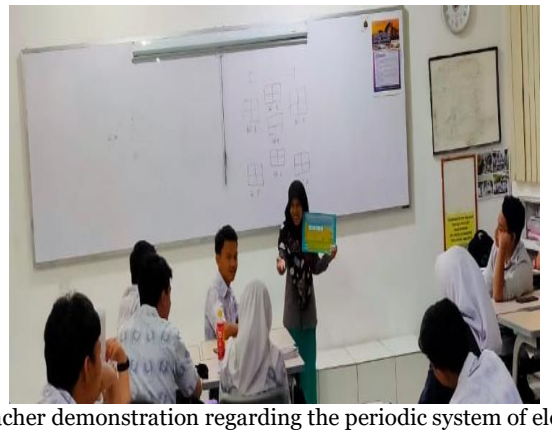

Figure 1. Teacher demonstration regarding the periodic system of elements (SPU)

The teacher displays the periodic system of elements and asks students to observe the elements contained in the periodic system. Students are invited to think to predict if these elements combine to form compounds, and then how many compounds will be formed. An excerpt from the dialogue in the apperception activity is as follows.

Subject time		conversation
06.06	G	This is the periodic table, right? try to pay attention to the periodic table of these elements! There are lots of elements
06.15	G	Take a look, and try to estimate that if these elements combine to form bonds, how many compounds will be formed?
06.26	SS	Lots
06.30	G	Try to estimate if there are a lot of compounds formed, even thousands of compounds, so how do we differentiate them?
06.44	S5	**Give me a name**
06.47	G	Anything else, anyone else wants to add?
06.50	S9	**Different colors**

Core activities

In the core activity, the teacher distributes student worksheets (LKS) to each student with the hope that students can be responsible for the assignments given.

Sharing tasks 1

In sharing task 1, students are given 10 minutes to discuss, the teacher sets a timer to train discipline so that learning is more effective and efficient. Then the remaining 10 minutes are used for student presentations. An excerpt from the dialogue from sharing task 1 can be seen in the following excerpt.

Time	Subject of conversation	
10.55	G	Mom, give me 10 minutes. To make it more effective, set a timer
11.03	S26	Just ask, ma'am, I don't understand, ma'am
11.08	S26	How is this?
11.12	S25	Yes, behind it there is an ida ida like that. I just forgot to look. The problem is that it is added with the name ida ida, the rule of tea.

11.26	S26	What is this?
11.27	S27	Na is sodium, Cl is chlorine. Then it becomes sodium chloride. Add ida like that behind it

From the excerpt from the dialogue that occurred in group seven, students have begun to find a tendency for repeated words, namely ida, in the names of these compounds. However, students are still confused about making nomenclature rules. It can be seen that students have only been able to identify the names of the elements of these compounds, but have not been able to classify these compounds into metals and non-metals. So the teacher needs help, and the teacher assists according to initial predictions. After that, they are expected to be able to do it independently. The teacher assists in the form of leading questions.

Sharing tasks 2

In sharing task 2, students work on the task of creating nomenclature rules for binary covalent compounds. Students observe a group of compounds, namely covalent compounds consisting of CO_2 (Carbon dioxide), NO_2 (Nitrogen dioxide), CCl_4 (Carbon tetrachloride), N_2O_4 (Dinitrogen tetroxide), and SF_6 (Sulfur hexafluoride). An excerpt from the dialogue from the sharing task 2 activity can be seen in the following excerpt.

Time of conversation subject

24.04	G	Okay. Now move on to the second sharing task.
24.17	S11	Mono, di, tri, tetra
24.20	S12	One is mono
24.28	S11	Those are metals and non-metals, right?
24.29	S12	Just a moment
24.33	S12	Composed of non-metals and non-metals with the naming starting from the non-metal element followed by the non-metal element and given the suffix ida.
25.14	S9	How, how, how?
25.20	S10	One point one point yes
25.36	S9	Is it nonmetal with nonmetal?
25.37	S12	Yes Starting from non-metals and followed by more non-metals.
26.39	S11	Huh, why is it happening again?
26.42	S11	Chloride, carbon dioxide, tetrachloride

From the excerpt from the dialogue that occurred in group three, it can be seen that students have been able to find the rules for nominating binary covalent compounds, even though they are not complete. Students state the nomenclature rules for binary covalent compounds, starting with non-metal, then non-metal, and ending with Ida.

Sharing tasks 3

In this sharing task activity, students investigate a group of compounds consisting of polyatomic ions and then make rules from the results of their observations. These groups of compounds are Na_2SO_4 (Sodium sulfate), $FeCO_3$ (Iron (II) Carbonate), $Ca(OH)_2$ (Calcium hydroxide), NH_4Cl (Ammonium chloride), and $Mg(NO_3)_2$ (Magnesium nitrate). Excerpts of student dialogue in sharing task 3 can be seen in the following excerpt.

Time of conversation subject

46.25	S2	How to create nomenclature rules for polyatomic compounds.
47.32	S1	Ooh... if the cation behind it has the word U
47.43	S1	For anions, there are at and ida
47.51	S4	Negative anion yes
48.44	S3	That's what you're looking for... keep asking. Too much looking
51.00	S1	1, determine the cation and anion
51.04	S1	2, if it's a cation, give it the suffix um, if it's an anion, give it the suffix at
51.20	S3	Here it is
51.29	S3	Naming starts from positive ions and continues with negative ions
51.34	S3	This is for non-metals that have more than one charge written in Roman numerals
51.40	S1	What is Rome?
51.41	S3	Do not know
52.18	S1	Pretentious... hurry up
53.04	S2	Is this anion?
53.06	S4	Yes, this is anion, cation

From the excerpt from the dialogue that occurred in group one, it can be seen that the students actively discussed and cared about their friends. Students can discover the nomenclature rules for polyatomic compounds. In sharing task three, the teacher's assistance began to decrease because students had begun to be able to do it themselves so the teacher's assistance was only for groups that needed help.

Jumping tasks

In this activity, students work on applicable assignments. Students are assigned to find the formula and chemical names of compounds on the market. These compounds are battery water, baking soda, chalk, English salt, and borax. Excerpts of student dialogue in the jumping task activity can be seen in the following excerpt.

Time of conversation subject

78.15	G	Write the formula and the chemical name
78.42	S22	Use the chemical name
78.49	S21	Sulfa acid
79.07	S21	Sodium hydrogen carbonate
80.36	S23	What's this? Carbonet?
80.45	S22	Calcium hydroxide
81.11	S22	Magnesium sulfate
81.48	S24	Eh, let's ask, wow
81.50	S23	What is that?
81.40	S23	How come there are so many?
81.42	S23	This is a password
81.54	S22	Yes, right. This is my writing
82.39	S23	So what else do you do, right?
82.41	S21	Na4B2
82.42	S23	Why add more? Which one?
82.45	S21	Borax

From the excerpt from the dialogue that occurred in group six, initially, the students thought they were only looking for the chemical formula but not the chemical name. After all students have finished working on the jumping task, the teacher asks students to present the results of their group discussion.

Meanwhile, critical thinking skills grow in activities *tasks* one as focusing questions, analyzing arguments, asking and answering clarifying/challenging questions, assessing the credibility of a source, observing and assessing observation reports, deduction and assessing deductions, induction and assessing induction, explaining symbols/formulas & assessing definitions & dimensions, identifying assumptions, decide on a course of action, and interact with others. The design form for sharing task 1 to develop students' critical thinking skills can be seen in Table 2. below.

Table 2. Form of Sharing Task 1 in Core Activities

Predicting Student Responses	Teacher Anticipation	CTS indicator
Sharing task I: How do you create nomenclature rules for ionic compounds? (20 minutes)		
Nomenclature rules: Metal element + non-metal element + suffix –ide	Observe the following groups of compounds, then conclude what the nomenclature rules are. Chemical Formula / Chemical Name NaCl – Sodium Chloride LiBr – Lithium Bromide NaI – Sodium Iodide SnO – Stano Oxide SnO_2 – Stani Oxide Ionic compounds consist of what elements? Try to pay attention to the tendency to name these compounds. The first name mentioned is the name for the metal or non-metal element. The second name? Then what word is added to the ending?	Focusing questions Analyze arguments Ask and answer clarifying/challenging questions Assessing the credibility of a source Observe and assess observation reports Deduction and assessing deductions Induction and assessing induction Explain symbols/formulas & assess definitions & dimensions Identify assumptions Deciding on a course of action Interact with other people

In sharing task 2, the predictions of students' responses were corrected by adding students' predictions stating that naming binary covalent compounds is preceded by the element that is more electropositive and

followed by the more electronegative element, the atom in front is called according to the name of the element followed by the name of the next element and given the suffix ida. , the number of atoms is referred to as a prefix using Latin numbers. Predicting the next response, students stated that the naming starts with a non-metal element followed by a non-metal element and is given the suffix ida. If two non-metal elements can form more than two types of compounds then the Greek prefix is used.

So, There are additional predictions for student responses regarding making nomenclature rules for covalent binary compounds, namely; 1) Number of non-metals + number of non-metals + suffix –ide, 2) Shows the number of atoms of the element in the compound, 3) naming covalent binary compounds is preceded by the more electropositive element and followed by the more electronegative element, the atom in front is called according to the name of the element followed by with the name of the next element and given the suffix ida, the number of atoms is referred to as a prefix using Latin numbers, 4) naming starts with the non-metal element followed by the non-metal element and given the suffix ida, if two non-metal elements can form more than two types of compounds then the language prefix is used Greece.

Meanwhile, critical thinking skills that grow in sharing task 2 activities are focusing on questions, analyzing arguments, asking and answering clarifying/challenging questions, assessing the credibility of a source, observing and assessing observation reports, deducting and evaluating deductions, inducing and assessing induction, and explaining symbols. /formula & assess definitions & dimensions, identify assumptions, decide on a course of action, and interact with others. The design form for sharing task 2 to develop student's critical thinking skills can be seen in Table 3 below.

Table 3. Form of Sharing Task 2 in Core Activities

Predicting Student Responses	Teacher Anticipation	CTS indicator
Sharing task 2:How do you create nomenclature rules for covalent compounds? (30 minutes)		
Number of nonmetals + number of nonmetals + suffix -ide. Shows the number of element atoms in the compound. The naming of covalent binary compounds is preceded by the more electropositive element and followed by the more electronegative element, the atom in front is called according to the name of the element followed by the name of the next element and is given the suffix ida, the number of atoms is referred to as a prefix using Latin numbers. The name starts with a non-metal element followed by a non-metal element and is given the suffix ida. If two non-metal elements can form more than two types of compounds, the Greek prefix is used.	Observe the following groups of compounds, then conclude what the nomenclature rules are. Chemical Formula / Chemical Name CO_2 – Carbon dioxide NO_2 – Nitrogen dioxide CCl_4 – Carbon tetrachloride N_2O_4 – Dinitrogen tetroxide SF_6 – Sulfur hexafluoride Covalent compounds consist of what elements? Try to pay attention to the tendency to name these compounds. What is the first name mentioned? The second name? Then what word is added to the ending? Are such rules enough? See what the words di, tetra, and hexa mean.	Focusing questions Analyze arguments Ask and answer clarifying/challenging questions Assessing the credibility of a source Observe and assess observation reports Deduction and assessing deductions Induction and assessing induction Explain symbols/formulas & assess definitions & dimensions Identify assumptions Deciding on a course of action Interact with other people

Meanwhile, critical thinking skills that grow in sharing task 3 activities are focusing on questions, analyzing arguments, asking and answering clarifying/challenging questions, observing and assessing observation reports, deducting and assessing deductions, induction and assessing induction, explaining symbols/formulas & assessing definitions. & dimensions, deciding on a course of action, and interacting with others. The design form for sharing task 3 to develop student's critical thinking skills can be seen in Table 4 below.

Table 4. Form of Sharing Task 3 in Core Activities

Predict student responses	Teacher anticipation	CTS indicator
Sharing task 3:How do you create nomenclature rules for polyatomic compounds? (40 minutes)		
Transition metal name (Biloxi) + nonmetal name (anion) Cation name + anion name + ida/at/it. Naming starts from the name of the cation (metal) followed by the polyatomic anion, the	Observe the following groups of compounds, then conclude what the nomenclature rules are. Chemical Formula / Chemical Name Na_2SO_4 – Sodium Sulfate Na_2SO_3 – Sodium Sulfite	Focusing questions Analyze arguments Ask and answer clarifying/challenging questions Observe and assess observation reports

number of an atom is written with Roman numerals after the atom is written. Starting with writing polyatomic ions which have a positive charge and continuing with writing polyatomic ions which have a negative charge and ending with the words ida/at. The prefix hypo is given to one type of compound that has fewer anions, and the prefix per anion is more.	$Fe(OH)_2$	Iron(II) Hydroxide	Deduction and assessing deductions Induction and assessing induction Explain symbols/formulas & assess definitions & dimensions Deciding on a course of action Interact with other people
	$Fe(OH)_3$	Iron(III) Hydroxide	
	$Ca(ClO)_2$	Calcium Hypochlorite	
	$Ca(ClO_2)_2$	Calcium Chlorite	
	$Ca(ClO_3)_2$	Calcium Chlorate	
	$Ca(ClO_4)_2$	Calcium Perchlorate	
	What is meant by a polyatomic ion? Try to group which are the cations, and which are the anions. Take a look at what the Roman numerals on the iron compounds indicate. Try to pay attention to the tendency to name these compounds. What is the first name mentioned? The second name? Then what word is added to the ending? Try to pay attention to the name of the compound! Some compounds end in –ide and some end in –at or –it. Take a look again! Some compounds start with -hypo and some start with -per.		

Critical thinking skills that grow in jumping task activities are analyzing arguments, asking and answering clarifying/challenging questions, assessing the credibility of a source, explaining symbols/formulas & assessing definitions & dimensions, deciding on a course of action, and interacting with other people. The form of jumping task design to develop students' critical thinking skills can be seen in Table 5 below.

Table 5. Form of Jumping Task in Core Activities

Predict student responses	Teacher anticipation	CTS indicator
Jumping tasks: How to determine the chemical formula and name of battery water, baking soda, chalk, English salt, and borax? (20 minutes)		Analyze arguments Ask and answer clarifying/challenging questions Assessing the credibility of a source Explain symbols/formulas & assess definitions & dimensions Deciding on a course of action Interact with other people

CONCLUSION

Based on the results and discussion, the sharing and jumping task learning design on the nomenclature of inorganic compounds are quite effective in fostering critical thinking skills, especially on the indicator "asking and answering clarifying/challenging questions". However, critical thinking skills are difficult to grow in the indicator of "making and judging valuable judgments".Through the implementation of sharing and jumping task learning designs on the nomenclature of inorganic compounds, the quality of learning can be improved and students' critical thinking skills can be developed. Future researchers can develop sharing and jumping task learning designs on other chemical materials and broader research subjects.

REFERENCES

Costa, A. L. (1991). Developing Minds A Resource Book for Teaching Thinking. Association for Supervision and Curriculum Development. *Education Resources Information Center (ERIC)*.

Fatimah, I., Hendayana, S., & Supriatna, A. (2018). Didactical design based on sharing and jumping tasks for senior high school chemistry learning. *Journal of Physics: Conference Series*, *1013*(1).

Femiceyanti, I., Rahardjo, S. B., & Yamtinah, S. (2019). Pengembangan Modul Kimia Berbasis Inkuri Terbimbing Pada Materi Larutan Penyangga Untuk Meningkatkan Keterampilan Berpikir Kritis Dan Keterampilan Proses Sains Siswa Kelas Xi Ipa Sma. *INKUIRI: Jurnal Pendidikan IPA*, *8*(2), 198. https://doi.org/10.20961/inkuiri.v8i2.37758

Gazali, F., & Dasna, I. W. (2023). Meningkatkan Keterampilan Berpikir Kritis Siswa dalam Pembelajaran Kimia. *Edukatif : Jurnal Ilmu Pendidikan*, *5*(3), 1401–1410. https://doi.org/10.31004/edukatif.v5i3.4290

Herlina, Heliawati, L., & Permana, I. (2019). NoMeningkatkan Keterampilan Berpikir Kritis Dan Kreatif Siswa Melalui Pembelajaran Tata Nama Senyawa Kimia Dengan Menggunakan Media Piringan KationAnion. *Journal of Science Education And Practice*, *3*(1), 19–32.

Istiana, G.A., Agung, N.C., & J. S. S. (2015). Penerapan Model Pembelajaran Discovery Learning Untuk

Meningkatkan Aktivitas dan Prestasi Belajar Pokok Bahasan Larutan Penyangga pada Siswa Kelas XII IPA Semester II SMA Negeri 1 Ngemplak Tahun Pelajaran 2013/2014. *Jurnal Pendidikan Kimia (JPK)*, *10*(1), 65–73.

Jones, P. & Hammon, J. (2016). Dialogic teaching in conversation with educational linguistics. *Research Papers in Education*, *31*(1), 1–4.

Liliasari. (2002). *Pengembangan Model Pembelajaran Kimia Untuk Meningkatkan Strategi Kognitif Mahasiswa Calon Guru Dalam Menerapkan Berpikir Konseptual Tingkat Tinggi*.

Litbang, K. (2013). Kurikulum 2013: Pergeseran Paradigma Belajar Abad-21. *Litbang.Kemdikbud.Go.Id*.

Redhana, W. I. (2015). Menyiapkan Lulusan FMIPA yang Menguasai Keterampilan Abad XXI. *Proceedings Seminar Nasional FMIPA UNDIKSHA*.

Rosyana, W., Ashadi, A., & Mulyani, S. (2019). PENGEMBANGAN INSTRUMEN PENILAIAN THREE-TIER MULTIPLE CHOICE (Three- TMC) UNTUK MENGUKUR KETERAMPILAN BERPIKIR KRITIS SISWA PADA MATERI KIMIA LARUTAN PENYANGGA KELAS XI SMA. *INKUIRI: Jurnal Pendidikan IPA*, *8*(1), 48. https://doi.org/10.20961/inkuiri.v8i1.31814

Sato. (2013). Mereformasi Sekolah : Konsep Dan Praktek Komunitas Belajar. *The Internasional Development Center of Japan Inc*.

Siti Nuraeni, Tonih Feronika, & Luki Yunita. (2019). Implementasi Self-Efficacy dan Keterampilan Berpikir Kritis Siswa Pada Pembelajaran Kimia di Abad 21. *Jambura Journal of Educational Chemistry*, *1*(2), 49–56. https://ejurnal.ung.ac.id/index.php/jjec/article/view/2553/1596

Wijaya, Y., Sudjimat, D., & Nyoto, A. (2016). Transformasi Pendidikan Abad 21 Sebagai Tuntutan Pengembangan Sumber Daya Manusia di Era Global. *Jurnal Pendidikan Universitas Malang*.

Yusfiani, dan S. (2006). Pengembangan dan Standarisasi Buku Ajar Kimia untuk SMA/MA Kelas XII Semester 1 Berdasarkan Standar Isi KTSP. *Jurnal Penelitian Bidang Pendidikan*, *17*(1), 38–48.

Zainal, Y. (2014). *Desain Didaktis Berbantuan Lesson Analysis Sebagai Selfreflection Pada Pembelajaran Penerapan Konsep Koloid dalam Kehidupan Sehari- Hari*.

Zoller, U. (1999). Scaling Up Of Higher-Order Cognitive Skills-Oriented College Chemistry Teaching'. *Journal Of Research In Science Teaching*.