Are Argumentation Skills Can Describe Understanding Concepts?

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ABSTRACT

Objective: Based on the several aspects, one aspect is quite important in the process of learning science, namely communicating. Argumentation is one of communication skills. Are argumentation can describe understanding concepts? Method: This study uses a literature review method from thirteen articles. Results: Argumentation skills can describe understanding concepts. Interpretation of the correlation coefficient shows that argumentation skills strongly correlate with understanding concepts. It is because argumentation skills positively correlate with critical thinking and logic skills. Argumentation skills can improve students' critical thinking level and logical skills in the thinking process. Everyone has good argumentation skills if has good critical thinking and good logic skills. Novelty: Argumentation skills are one of the communication skills that improve understanding of concepts. Argumentation skills are moderators for high-order thinking skills. It can occur because the components of argumentation skills are claim, evidence, and reasoning. Someone can meet all the argumentation skills components with good thinking.

INTRODUCTION

Science is defined as three main pillars, namely, science as an attitude, science as a process, and science as a product. Concepts are the product of science. The concept is a collection of stimuli with the same attributes for organizing knowledge and experience into categories. Understanding concepts in science learning is an important aspect. Every student must have an understanding of concepts, namely scientific concepts. The Southeast Asian Ministers of Education Organization (SEAMEO) webinar in September 2022 explained that six skills are needed in 21st-century education: character, citizenship, critical thinking, creativity, collaboration, and communication. Three of the six skills critical, creative, and communication are higher-order thinking skills (Baguma et al., 2019; Kwangmuang et al., 2021; Lu et al., 2021; Nahar et al., 2022; Suherman et al., 2020; Supena et al., 2021). Higher-order thinking skills are the ability to think strategically to use information in solving problems, analyzing arguments, negotiating issues, or making predictions (Al-Husban, 2020; Alsaleh, 2020; Lu et al., 2021; Munawati, 2019; Quinn et al., 2020).

Learning is directed at creating an active, critical, analytical, and creative atmosphere in problem-solving through developing thinking skills. This thought process includes several aspects such as observing, classifying, measuring, looking for relationships, conducting experiments, and communicating (Alsaleh, 2020; Dökmeçioglu et al., 2022; Eslami et al., 2019; Henriksen et al., 2020; Lacerda et al., 2020; Lu et al., 2021; Munawati, 2019; Quinn et al., 2020; Radianti et al., 2020; Setiadi & Elmawati, 2019; Taques et al., 2021;...
Yaniawati et al., 2020). Based on the several aspects that have been mentioned, there is one aspect that is quite important in the process of learning science, namely, communication. One of communication skill is argumentation. Argumentation is defined as a language skill to influence the attitudes and opinions of others to match what the writer or speaker wants. Argumentation skills are needed to respond some scientific issues that occur in today's society, make decisions, assess a claim that arises both through mass media and other media based on valid and reliable evidence (Bencze et al., 2020; Bodé et al., 2019; Fjelland, 2020; Gericke et al., 2022; Ke et al., 2021; Maass et al., 2019; Noroozi, 2022; Priemer et al., 2020).

Argumentation skills are critical to be applied in learning to improve the skills demanded in 21st-century learning in order to prepare students to face the Industrial Revolution 5.0 (Anita et al., 2019). Argumentation is usually in the science learning process based on data and evidence to support explanations of scientific concepts (Bayram-Jacobs et al., 2019; Manz et al., 2020; Panadero & Jonsson, 2020; Zhai et al., 2020; Zhu et al., 2020). Argumentation skills are growing slowly, but argumentation skills must be learned carefully. In this case, we will discuss scientific argumentation. The use of scientific argumentation in teaching is of great importance as it makes the students' engagement more effective in the teaching and learning process, as it helps develop their ideas because they come to know themselves rather than presenting them in ready-made templates. Teaching individuals how to engage in discussions and use scientific evidence in these discussions is essential for future decision-making, especially when students are faced with controversial issues. Therefore, science should play a critical role in developing future citizens with such skills (Coy et al., 2021; García-Feijoo et al., 2020; Nguyen et al., 2020; Nugroho et al., 2019; Orgill et al., 2019). Uncertainty in argument created productive moments for students to collaborate in dialogue and direct their understanding of natural phenomena toward more coherent scientific explanations. Based on this explanation, the author has two research questions: 1) Can argumentation skills describe understanding concepts? 2) How can argumentation skills describe understanding concepts?

RESEARCH METHOD
This study uses the literature review method. A literature review is a written summary of journal articles, books, and other documents that describe the past and current state of information on the topic of research study. This data was collected from thirteen articles. The author uses the document analysis method to analyze data. Detail of research method in Figure 1.
Document analysis is a systematic procedure for reviewing or evaluating printed and electronic documents (computer-based and Internet-transmitted) documents. Document analysis is a technique that enables researchers to study human behavior through an analysis of their communications. The first author collected 150 articles from some search engines. The article is divided into four topics: argumentation skills, critical thinking, understanding concepts, and logic skills. Then, the author collected some articles with mutual support and found 13. The articles are grouped into three topics: argumentation skills and understanding concepts, argumentation skills and critical thinking, and argumentation skills and logic skills. The articles are analyzed and synthesized into a make-sense paragraph.

RESULTS AND DISCUSSION

Results

Some research in Table 1 shows the correlation between argumentation skills and understanding concepts. Table 2 shows argumentation skills can improve critical thinking. Table 3 shows the argumentation process includes logic skills.

Table 1. Some research shows a correlation between argumentation skills and understanding concepts.

<table>
<thead>
<tr>
<th>Author</th>
<th>Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apriliani et al., (2019)</td>
<td>Correlational</td>
<td>The correlation between conceptual knowledge and argumentation skills obtained a Pearson correlation coefficient of 0.419 and a sig value of 0.007</td>
</tr>
<tr>
<td>Sarira et al., (2019)</td>
<td>Correlational</td>
<td>There is a significant correlation between argumentation skills and cognitive learning outcomes (significant value 0.000&lt;0.050) with a correlation coefficient (r) 0.786</td>
</tr>
<tr>
<td>Pratiwi et al., (2019)</td>
<td>Descriptive qualitative</td>
<td>Problem-based learning that implements argumentation skills can improve conceptual understanding of the relationship between buoyant force and sinking volume. The correlation coefficient obtained a value of 0.639. This indicates a high correlation between the argumentation</td>
</tr>
</tbody>
</table>
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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Paramita et al., (2020)</td>
<td>Quasi Experiment post only</td>
<td>The experiment class better understands concept and argumentation skills than the control class.</td>
</tr>
<tr>
<td>Amin et al., (2022)</td>
<td>Correlational</td>
<td>The regression equation derived from the data analysis is ( y = 0.608x + 39.05 ) with a reliability value of 0.179, indicating that conceptual knowledge accounts for 82.10% of argumentation skills and other factors account for 17.90% of argumentation skills.</td>
</tr>
</tbody>
</table>

**Table 2.** Argumentation skills can improve critical thinking.

<table>
<thead>
<tr>
<th>Author</th>
<th>Method</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suraya et al., (2019).</td>
<td>Descriptive</td>
<td>Students' argumentation abilities are at levels 2, 3, and 4, and students' critical thinking skills are at the Unacceptable and strong levels, where both argumentation skills and critical thinking are equivalent.</td>
</tr>
<tr>
<td>Hasnunidah et al., (2020).</td>
<td>Correlational Study</td>
<td>The correlation between students' understanding of basic biology concepts and their argumentation and critical thinking skills is very high (ADI = 0.886; R Conventional = 0.817). Moreover, the contribution of students' argumentation skills to their understanding of basic biology concepts (ADI = 0.600%; Conventional = 0.800%) was lower than the contribution of their critical-thinking skills (ADI = 88.000%; Conventional = 80.900%).</td>
</tr>
<tr>
<td>Haruna &amp; Nahadi, (2021).</td>
<td>Quantitative research</td>
<td>Argumentation ability is closely related to critical thinking ability. Students with low argumentation level (level 1) have low critical thinking skills (level 1). Students with a high argumentation level (level 4) have high critical thinking skills (level 4).</td>
</tr>
<tr>
<td>Winarti et al., (2021).</td>
<td>Correlation</td>
<td>There is a correlation between critical thinking and writing argumentative text. It shows that argumentation skills can describe critical thinking and writing skills.</td>
</tr>
<tr>
<td>Ristanto et al., (2022).</td>
<td>Quasi-experiment, pretest-postest control group design</td>
<td>The Guided Discovery Learning Argument Mapping implementation was proven capable of influencing critical thinking skills on environmental changes, and it was better than the control class. The GDL and argument mapping had characteristics that enabled students to develop a way of thinking, thus training their critical thinking skills.</td>
</tr>
</tbody>
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<th>Author</th>
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<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demircioglu et al., (2023)</td>
<td>Qualitative</td>
<td>Students' frequency of using critical thinking skills varies according to the use of the argumentation method.</td>
</tr>
<tr>
<td>Ekanara et al., (2018)</td>
<td>Correlational</td>
<td>The value of reasoning ability and argumentation skills obtained in this study show a strong and positive relationship. This is shown by the results of this study, which obtained a correlation coefficient ( r ) of 0.760. The ( r ) value means that reasoning ability and argumentation skills have a strong positive relationship.</td>
</tr>
<tr>
<td>Al-Ajmi &amp; Ambusaidi. (2021)</td>
<td>Survey approach</td>
<td>There is a correlation between argumentation skills and logical skills.</td>
</tr>
</tbody>
</table>

**Table 3. The argumentation process includes logic skills.**

**Discussion**

Argumentation is gathering the various components needed to build an argument. Argumentation is a discursive process for making claims, providing evidence to support claims, and criticizing. In education, argumentation skills can encourage students to provide facts, data, and theories that are appropriate to support claims against a problem and can be accounted for (Rahayu et al., 2020; Hardini & Alberida, 2022). In another definition, it is explained that argumentation skills are a form of thinking skills possessed by a person in compiling knowledge claims that are supported by evidence and strengthened by reason when assessing a phenomenon (Allchin & Zemplén, 2020; Kaeppel, 2021; Kim et al., 2022; Maknun, 2020; Nussbaum, 2021; Ping et al., 2020; Rapanta, 2021).

Argumentation skills can be in the form of a student's ability to understand the issues being debated, find and understand relevant information, assess the strengths and weaknesses of arguments, build strong and consistent arguments, present arguments clearly and effectively, accept and respond to criticism well so that they can make appropriate and logical conclusions (Ekanara et al., 2018). According to Roviati & Widodo (2019), indicators of argumentation skills include the ability to identify, evaluate, and make arguments. Based on the Toulmin Argumentation Pattern (TAP) argumentation model, the quality of the argument consists of six components, including claims, data, warrants, backing, rebuttals, and qualifiers (Toulmin, 1958). The argumentation component consisted of claims, evidence, and reasoning. Specifically, argumentation skills are divided into four components, namely (1) compiling claims, (2) showing evidence, (3) compiling reasons, and (4) compiling counterarguments (Chin & Osborne, 2010).

Argumentation skills correlate with student understanding. This statement is supported by several studies by Apriliani et al. (2019) which state that the correlation between conceptual knowledge and argumentation skills obtained Pearson correlation coefficient 0.419 and sig value 0.007; Sarira et al (2019) correlational there are significant correlation between argumentation skills and cognitive learning outcomes (significant
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value 0.000<0.050) with correlation coefficient (r) 0.786; Pratiwi et al (2019) Problem based learning that implements argumentation skills can improve students' conceptual understanding of the relationship between buoyant force and sinking volume; Paramita et al (2020) Experiment class has a better understanding of concepts and argumentation skills than control class; Amin et al (2022) The regression equation derived from the data analysis is $y = 0.608x + 39.050$ with a reliability value of 0.179, indicating that conceptual knowledge accounts for 82.10% of argumentation skills and that other factors account for 17.90% of argumentation skills. Interpretation of the correlation between the two variables is shown in Table 4.

### Table 4. Interpretation of correlation coefficient.

<table>
<thead>
<tr>
<th>Correlation Coefficient</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>There is no correlation between the two variables</td>
</tr>
<tr>
<td>&gt;0.000-0.250</td>
<td>Very weak correlation</td>
</tr>
<tr>
<td>&gt;0.250-0.500</td>
<td>Medium Correlation</td>
</tr>
<tr>
<td>&gt;0.500-0.750</td>
<td>Strong correlation</td>
</tr>
<tr>
<td>&gt;0.750-0.990</td>
<td>Solid correlation</td>
</tr>
<tr>
<td>1.000</td>
<td>Correlation of perfect positive relationship</td>
</tr>
<tr>
<td>-1.000</td>
<td>Correlation of perfect negative relationship</td>
</tr>
</tbody>
</table>

### Table 5. Interpretation of correlation coefficient obtained from several studies.

<table>
<thead>
<tr>
<th>Author</th>
<th>Correlation Coefficient</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apriliani</td>
<td>0.419</td>
<td>Medium correlation</td>
</tr>
<tr>
<td>Pratiwi</td>
<td>0.639</td>
<td>Strong correlation</td>
</tr>
<tr>
<td>Amin</td>
<td>0.608</td>
<td>Strong correlation</td>
</tr>
<tr>
<td>sarira</td>
<td>0.786</td>
<td>Solid correlation</td>
</tr>
</tbody>
</table>

The correlation coefficient between arguments obtained from several studies is summarized in Table 5. Argumentation skills strongly correlate with conceptual understanding. This is supported by Chin & Osborne (2010), who interpret that arguments are obtained from thought processes that play an essential role in developing students' understanding. The results of other studies that strengthen the correlation between argumentation skills and understanding of concepts are as follows.

**Argumentation Skills Are Related to Critical Thinking**

Critical thinking is a component of higher-order thinking skills (HOTS). As critical thinking, HOTS is defined as the skill of giving wise judgments and criticizing something using logical and scientific reasons. Critical thinking is deciding what to do or believe (Saphira & Prahani, 2022). Someone who has good critical thinking skills will also have a good understanding. Indicators of critical thinking skills based on Ennis' opinion are:

a. Give a simple explanation.
   - Focus problem
   - Analyze arguments
   - Ask and answer clarifying questions or challenging questions

b. Build basic skills
   - Consider the source
   - Observe and consider the results of observations

c. Making inferences
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- Make a deduction and consider the results of the deduction, or make an induction and consider the results.
- Make decisions and weigh the results.

d. Provide further explanation
- Define terms and consider definitions
- Identify assumptions

e. Set strategy and tactics
- Formulate and decide on an action
- Present arguments orally or in writing

From the indicators sparked by Ennis, it can be stated that critical thinking is related to argumentation skills. This statement is supported by research conducted by Suraya et al. (2019) that students' argumentation abilities are at levels 2, 3, and 4 and students' critical thinking skills are at the Unacceptable and strong levels, where both levels of argumentation skills and critical thinking are at equivalent levels; Hasnunidah et al (2020) said that the correlation between students' understanding of basic biology concepts and both their argumentation and critical thinking skills is very high (R ADI = 0.886; R Conventional = 0.817). Moreover, the contribution of students' argumentation skills to their understanding of basic biology concepts (ADI = 0.600%; Conventional = 0.800%) was lower than the contribution of their critical-thinking skills (ADI = 88%; Conventional = 80.900%); Haruna & Nahadi (2021) said that argumentation skills are closely related to critical thinking skills. Students with low argumentation level (level 1) have low critical thinking skills (level 1). Students with a high level of argumentation (level 4) have high critical thinking skills (level 4; Winarti et al. (2021) said that There is a correlation between critical thinking and writing argumentative text. It shows that argumentation skills can describe critical thinking and writing skills. The Guided Discovery Learning Argument Mapping implementation was proven capable of influencing critical thinking skills on environmental changes, and it was better than the control class. The GDL and argument mapping had characteristics that enabled students to develop ways of thinking, thus training their critical thinking skills. Demircioglu et al. (2023) said that the frequency of using critical thinking skills by students varies according to the use of the argumentation method. The mapping of argumentation skills with indicators of critical thinking is explained in Table 6.

<table>
<thead>
<tr>
<th>Code</th>
<th>Critical Thinking Indicators</th>
<th>Component of Argumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>Distinguish relevant and irrelevant information</td>
<td>Claim</td>
</tr>
<tr>
<td>K2</td>
<td>Detect error and correct conceptual errors</td>
<td>Rebuttal and backing</td>
</tr>
<tr>
<td>K3</td>
<td>Test the problem openly</td>
<td>Data</td>
</tr>
<tr>
<td>K4</td>
<td>Analyze the problem</td>
<td>Warrant</td>
</tr>
<tr>
<td>K5</td>
<td>Understanding the characteristics of a particular, even if it is changed in form</td>
<td>Warrant</td>
</tr>
<tr>
<td>K6</td>
<td>Conclude all the facts have been gathered and considered</td>
<td>Claim, Data + Warrant</td>
</tr>
</tbody>
</table>

Table 6. Mapping indicators of argumentation skills and critical thinking.
Argumentation Skills Correlate With Logic or Reasoning Skills

Logic is a branch of science that seeks to derive conclusions through valid formal rules. Logic is a thinking process that is systematic and bound to specific rules. Logic is the knowledge and skills to think straight and precisely. The ability to think logically has been identified as essential to support the development of learning science and mathematics (Arytunova & Gykasyan, 2021; Rizaldi et al., 2020). The ability to think logically includes five types of reasoning, namely proportional, controlling variables, probability, correlational, and combinatorial (Fitria & Malik, 2022; Nopriana et al., 2021; Rohaeti et al., 2019; Sanjayanti et al., 2019 2020). Proportional reasoning is essential in the quantitative aspects of chemistry, especially for understanding the derivation and use of many functional relationships in chemistry, such as the development and interpretation of tabular and graphical data. Correlational reasoning plays a role in formulating hypotheses and interpreting data that needs to consider the relationship between variables—control of essential variables in planning, implementation, and interpretation. Interpreting data from findings, observations, or experiments often requires probabilistic reasoning. Combinatorial reasoning occurs in formulating alternative hypotheses to test the effect of the selected variables.

A learner is considered to have good argumentation skills if he can compile claims, show evidence for the claims made, and provide appropriate explanations for the evidence shown (Chin & Osborne, 2010). The explanation built must be per the evidence shown. Evidence can be in the form of phenomena in everyday life, practicum results, and data that support claims (Ginanjar & Utari, 2015). Evidence is explained by appropriate theories, concepts, and laws so that the arguments presented are accurate, reasonable, and acceptable. Therefore, a student must have good logical skills and conceptual understanding in building compatibility between evidence and explanation.

Logic skills are essential to fulfill the reasoning component in argumentation skills. This statement is supported by research conducted by Ekanara et al. (2018), who said that the value of reasoning ability and argumentation skills obtained in this study show a strong and positive relationship. This is shown by the results of this study, which obtained a correlation coefficient \( r \) of 0.760. The \( r \) value means that reasoning ability and argumentation skills have a strong positive relationship. Research conducted by Ajmi et al. (2021) said there is a correlation between argumentation and logical skills.

CONCLUSION

Fundamental finding: Argumentation skills can describe understanding concepts. Interpretation of the correlation coefficient shows that argumentation skills strongly correlate with understanding concepts. It is because argumentation skills positively correlate with critical thinking and logic skills. Argumentation skills can improve students’ critical thinking level and logical skills in the thinking process. Everyone has good argumentation skills if has good critical thinking and good logic skills. Implication: This research can be a reference for argumentation skills, understanding concepts, critical thinking, and logic skills. Limitation: This study is limited to analyzed from some literature. There have yet to be experiments in this study. Future research: Teachers must often apply argumentation skills in the learning process because argumentation skills can explain understanding concepts of student
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