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Analysis of Science Textbooks from The Aspect of Scientific Argumentation: Comparing Several Books on The Topic of Heat

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ABSTRACT

This research aims to analyze the 2013 Curriculum Middle School Science textbooks published by the Ministry of Education and Culture and Erlangga publications used in Indonesia when compared with the Lower Secondary Science Matters textbooks used in science learning in Singapore in terms of the aspect of scientific argumentation on the topic of heat. This research is qualitative research analyzed using the constant comparison method. The data analysis process was carried out through five stages, namely reduction, organizing, categorization, synthesis and developing working hypotheses. After the organizing stage, a data validity test is carried out using credibility, transferability, anteriority and confirmability techniques. The results of the research found that there were differences in the scientific argumentation aspects of the three textbooks, namely the majority of the Lower Secondary Science Matters textbooks were at level 3, while the majority in the 2013 Curriculum Middle School Science textbooks published by the Ministry of Education and Culture and those published by Erlangga were at level 2. In the Curriculum Science textbooks The 2013 edition of the Ministry of Education and Culture from Indonesia provides more statements accompanied by supporting sentences to prove the truth in the form of data, experiments, observations in daily life, and pictures that illustrate a situation, whereas the Lower Secondary Science Matters textbook provides more statements (claim) which is accompanied by supporting sentences to prove its truth in the form of data, experiments, observations in daily life, and pictures that illustrate a situation (data), then reinforced by sentences that connect them (warrant).

Keywords: *scientific argumentation, Toulmin's Argument Pattern (TAP), science textbook.*

INTRODUCTION

Argumentation is a statement containing claim accompanied by support proposed to influence someone (Edward S. Inch, Barbara Warnick, 2006, p. 9). Scientific arguments are the basis for students to think, act and communicate (Probosari et al., 2016). Through argumentation, someone is able to assemble the facts they obtain to prove whether their opinion is correct or not (Gorys, 2007). Scientific arguments are very important to be involved in learning where students are able to make claims that are supported by evidence (Sampson et al., 2011). Based on several studies, it shows that students are able to develop a deeper understanding of content when involved in argumentation (Von Aufschnaiter et al., 2008).

Based on the PISA framework, the abilities possessed by students are related to the ability to make scientific arguments. The three scientific competencies put forward in (OECD, 2019), namely (1) explaining a phenomenon scientifically, the relationship with the ability to scientific argumentation is that scientific argumentation is different from argumentation in everyday life, namely providing scientifically proven statements that refer to measurements and observations. (Probosari et al., 2016). So that through scientific argumentation we can explain a phenomenon

scientifically (2) evaluate and design scientific inquiry, its relationship with scientific argumentation, namely the ability to make scientific arguments is closely related to inquiry learning, namely meaningful learning through discovery which is a characteristic of science learning (Bricker & Bell, 2008). Argument-based inquiry learning is learning that involves students in an investigation process that produces understanding and explanations supported by relevant evidence (Chen et al., 2016), and the third framework (3) interprets data and evidence scientifically, its relationship with scientific argumentation, namely scientific argumentation connects data/evidence obtained with claims that are formed and strengthened with justification (warrants) and support (backings) (Erduran, 2004).

Based on the relationship between the PISA framework on scientific competence and scientific argumentation ability, if it is related to the results of the PISA survey on science ability in 2018, the scientific argumentation ability of students in Singapore is much better compared to Indonesia. This is proven by Indonesia's PISA ranking which is ranked 71st out of 79 countries with an average score of 396, lower than Singapore which is ranked 2nd with an average score of 489 (OECD, 2019). From the results of a preliminary study conducted by (Sumarni et al., 2020) it is clear that students' argumentative abilities are not yet scientific. This is an indication that students in conveying scientific arguments are still related to everyday life, not yet linked to science concepts, especially on one of the topics that is still difficult to understand, namely the topic of heat. Students still have difficulty understanding the topic of heat because from the results of interviews, students think that science is not part of life, that is, they think that science is only subject matter taught at school, so that when students are asked to argue their answers are not scientific. Apart from that, teachers who teach science in their main field are not science but only biology or physics.

The results of a preliminary study (Sumarni et al., 2020) by distributing questionnaires and interviews to MGMP science teachers in the city of Magelang show that few teachers practice scientific argumentation in science learning. There are 31.3% of teachers who have trained in scientific argumentation and 31.3% who have never trained in scientific argumentation. The remainder are teachers who do not know about scientific arguments, amounting to 37.5%. This means that 68.8% of Magelang City science teachers have not trained scientific argumentation with students. Meanwhile, scientific argumentation needs to be trained on students in science learning.

One tool for practicing scientific argumentation is through textbooks. Textbooks help in the learning process and have the benefit of clarifying the delivery of information which can improve the learning process (Henry Guntur Tarigan, 2009). Textbooks in learning function as guidelines for students (Bintang Sitepu, 2012). The main learning source used in class based on the results of a preliminary survey by Sumarni et al., (2020) is the 2013 Curriculum Science textbook published by the Ministry of Education and Culture at 93.8% and 6.3% from non-government, namely the Integrated Science Textbook for Middle School/MTs published by Erlangga. One of the textbooks used in science learning in Singapore is the book. Lower Secondary Science Matters published by Marshall Cavendish Education which has been officially approved by the Singapore Ministry of Education for use in learning. Books that have been approved are marked with a Singapore Ministry of Education stamp on the title page (Approved Textbook List | MOE, 2021). It is not yet known whether these three textbooks train argumentation skills or not because no one has done research before.

There are differences in PISA results between Indonesia and Singapore and existing problems, so it is necessary to analyze the textbooks used in Indonesia, namely the 2013 Curriculum Middle School Science textbooks published by the Ministry of Education and Culture and those published by Erlangga, as well as the Lower Secondary Science Matters textbook from

Singapore reviewed in the aspect of scientific argumentation on the topic of heat. So, it is important to carry out this research to see whether scientific argumentation is practiced or not in the textbook. To analyze scientific arguments in the 2013 Curriculum Middle School science textbooks, refer to the Toulmin argumentation model or Toulmin's Argument Pattern (TAP) which consists of 6 important indicators in an argument, namely claim, data, warrant, backing, qualifier, and rebuttal (Toulmin, 2003).

METHODOLOGY

This research is research with a qualitative approach. One of the functions and uses of qualitative research is to examine a background such as motivation, roles, values, attitudes and perceptions (Lexy J. Moleong, 2007). The research design can be seen on Figure 1.

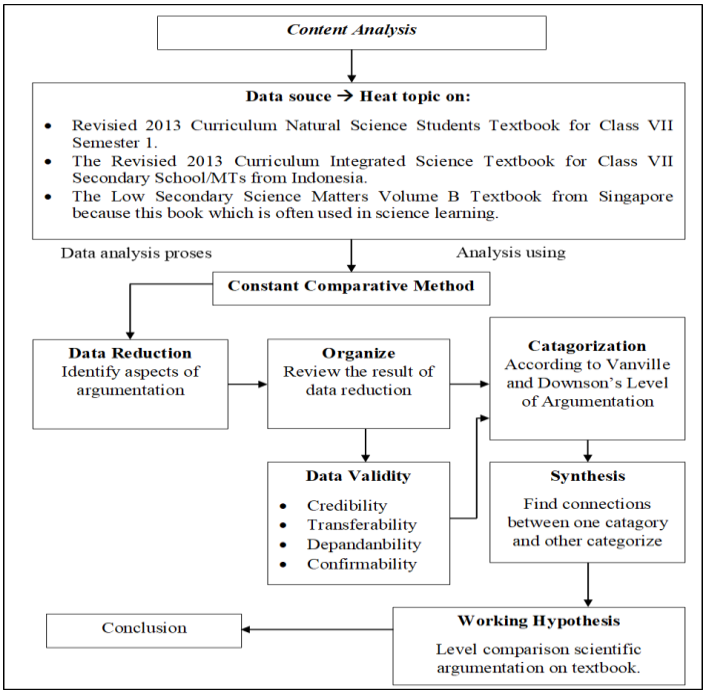


Figure 1. Reseach Design

Research focus

The subjects used were the revised 2013 Curriculum Natural Science student textbook for Class VII Semester 1, the revised 2013 Curriculum Integrated Science textbook for Class VII Middle School/MTs from Indonesia and the Low Secondary Science Matters Volume B textbook from Singapore because this book which is often used in science learning.

Data and Research Data Sources

The data sources used are the 2013 Revised Edition of the 2013 Curriculum Natural Sciences student textbook for Middle School Class VII Semester 1 published by the Indonesian Ministry of Education and Culture, the revised 2013 Curriculum Integrated Science textbook for Class VII Middle School/MTs and the *Lower Secondary Science Matters textbook 2 nd Edition Volume B* published by *Marshall Cavendish Education* in accordance with the 2013 curriculum from Singapore.

Data collection technique

The data collection technique used is a documentation technique, namely by analyzing aspects of scientific argumentation on the topic of heat in the 2013 Curriculum Middle School science textbook for class VII Semester I, the revised 2013 Curriculum Integrated Science textbook for Class VII Middle School/MTs, and *Low Secondary Science Matters Textbook Volume B.* On this research, Toulmin's Argumentation Pattern was used (Table 1). List of text elements analyzed, namely complete paragraphs, images and tables 1.

Table 1. Aspect of Toulmin's Argumentation

No	Argumentation Aspect	Aspects of analysis that are analyzed in textbooks
1	Claim	Provide a stated statement
2	Data	There are facts or evidence used to prove the claim
3	Warrants	There are general logical statements and hypotheses that are used to connect claims with data
4	Backing	Further statements supporting the warrant to prove the truth of the warrant

To make it easier to analyze aspects of scientific argumentation in the contents of the textbook, several questions are assisted, such as what is the main topic/statement of the author? (to identify claim). What evidence/facts or reasons can justify the claim? (to identify data). What guarantees strengthen and link the claim to the data? (to identify warrants), and what questions support warrants? (to identify backing).

Data analysis technique

The analysis technique used in this research is the constant comparison method. The analysis process carried out includes data reduction, organizing, categorization, synthesis, and developing working hypotheses. (1) In data reduction process, the argumentation aspects of science textbooks on the topic of heat are identified; (2) Organizing, look again at the results of data reduction so that they comply with the criteria for the scientific argumentation aspect, namely containing claim, data, warrant, backing, qualifier, and rebuttal that match the criteria; (3) Categorization, after the data is reviewed, it is then categorized according to Toulmin's Argument Pattern namely pattern C, C-D, C-D-W, C-D-W-B, C-D-W-Q; C-D-W-B-Q. Based on the results of the analysis, the average percentage of each scientific argumentation pattern found was calculated using the formula (1) and using Table 2 for analysis the level of argumentation; (4) Synthesis, we look for links between one category of each level of argumentation and other categories of argumentation levels, so that descriptions are found that show arguments at levels 1 to level 4; (5) Develop a working hypothesis, after analyzing the three textbooks on the scientific argumentation aspect, it was found that there were differences in the scientific argumentation aspects of the three textbooks.

Table 2. Analysis Framework Used to Determine Argumentation Levels

Levels	Criteria
1	Describing arguments only in the form of claims
2	Describe the claim supported by data (supporting information)
3	Describe the claim supported by data, and/or warrant,
4	Describe the claim, data and/or warrant, backing, and qualifier

(Venville & Dowson, 2010)

RESULT AND DISCUSSION

Results of the Analysis of Scientific Argumentation Aspects in the 2013 Curriculum Middle School Science Textbook Revised Class VII Edition Published by the Ministry of Education and Culture, the 2013 Curriculum Middle School Integrated Science Textbook Published by Erlangga, and the Lower Secondary Science Matters 2 nd Edition Volume B Textbook on the topic of heat, 4 elements of scientific argumentation are identified which are interconnected to form Toulmin's argumentation pattern. The first pattern is C where the element claim is identified without any support in the form of evidence/data, warrant, backing, qualifier, and rebuttal. The second pattern is the C-D pattern which only contains the claim and data aspects, the third pattern is the C-D-W pattern where the argument contains the claim, data, and warrant, and the fourth pattern, namely the C-D-W-B pattern where the argument contains the elements claim, data, warrant, and backing. The percentage level of scientific argumentation in the three textbooks can be seen in Table 3.

Table 3. Percentage of Scientific Argumentation Levels from Three Textbooks

Patterns of Scientific Argumentation	Argumentation Level	Book 1 (Kemendikbud science book)	Book 2 (Erlangga Science book)	Book 3 (Singapore science book)
C	Level 1	22.222%	12.5%	6.667%
CD	Level 2	41.667%	59.375%	36.667%
C-D-W	Level 3	33.333%	25%	53.333%
C-D-W-B	Level 4	2.778%	3.125%	3.333%
∂		100%	100%	100%

The following is an example of a comparison of scientific arguments based on the availability of the elements claim, data, warrant, backing, and qualifier. The results of the analysis found patterns in each book sequentially, namely the C-D-Q, C-D-W, C-D-W-B patterns in different textbooks with the same discussion, namely in the heat transfer sub-chapter with a discussion of conduction in solids. The scientific argumentation paragraph in the revised edition of the 2013 Curriculum 2013 Middle School Science textbook for Class VII Semester 1 published by the Ministry of Education and Culture can be seen on Figure 2.

Objects of different types have different abilities to conduct heat through conduction (conductivity). Materials that are able to conduct heat well are called conductors. Materials that conduct heat poorly are called insulators (warrants). As your experimental results show, metals are conductors. Wood and plastic are insulators (claim). Various household appliances that utilize the conductivity properties of materials can be seen in Figure 4.14. (data)

Figure 2. Example of a Scientific Argumentation Paragraph in the Revised Edition of the 2013 Curriculum 2013 Middle School Science textbook for Class VII Semester 1 published by the Ministry of Education and Culture.

The next sentence shows claim indicating that this sentence is a statement or main point of an experimental result. To analyze claim it is assisted by the question "what is the main point you want to convey?". The proof of claim above is in a picture which provides examples of

conductor and insulator materials where the ability to conduct heat better is shown in the direction of the arrow. This can be used as data of claim. In analyzing data it is assisted by the question "what are the reasons and evidence to support it?.

The first paragraph shows the existence of warrant, namely in the form of a general statement or hypothesis from existing data to connect claim with data. In analyzing warrant it is assisted by the question "what is the guarantee to strengthen the evidence and connect the two?". On page 186 of the Integrated Science textbook for Middle School Class VII Revised 2013 Curriculum Erlangga Publisher can be seen on Figure 3.

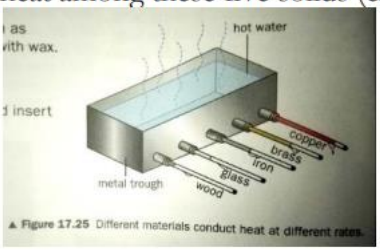
Conductor of heat in different materials.

1. Provide 4 rod-shaped objects made from different materials (for example copper, aluminum, iron and wood) and a spirit burner or Busen burner, 4 candles and matches.
2. Arrange the tools as shown in the picture on the side.
3. Place the candle on One end of the four objects at the same distance,
4. Heat the four objects using a spirit burner or busen burner placed in the middle.
5. Observe what happens to each candle. It turns out that copper metal conducts heat faster than wood (data).

In general (Qualifier) metal is a good conductor of heat (claim)

Figure 3. Scientific Argumentation Paragraph show the Claim, Data, and Qualifier in the Textbook Middle School Class VII Revised 2013 Curriculum Erlangga Publisher

Three following experiments show the rate of heat flow through different materials. Experiment 1: conduction of heat through different materials Coat roads of different materials, such as glass, copper, brass, iron, and wood with wax. Place the rods into a rubber bung and insert it into the side of a metal trough.Pour hot water into the troughAfter some time, the wax on the copper rod melts the fastest, followed by brass, iron, glass, and finally, wood (data)..This shows that copper is the best conductor of heat among these five solids (claim) Figure 17.26.



Different materials conduct heat at different rates (warrant). Scientist at Work Joseph Black (1728-1799) Joseph Black was a Scottish scientist who is known for his research on the effect of heat on different materials. He observed that the temperature of melting ice remained the same as it melts even though heat is absorbed. this discovery is now known as latent heat. He also observed that equal masses of different substances require different amounts of heat to raise their temperature by 1 (backing).

Figure 4. Scientific Argumentation Paragraph in the Textbook Lower Secondary Science Matters 2nd Edition Volume 2

The scientific argumentation paragraph in the textbook Lower Secondary Science Matters 2nd Edition Volume 2 can be seen on Figure 4. Based on the argumentation paragraph above, four elements of scientific argumentation were found, namely claim, data, warrant, and backing which are connected to form a D-C-W-B pattern by asking the question "what is the main point?" found claim. "This shows that copper is the best conductor of heat among these five

solids", the meaning is "this shows that copper is the best conductor of heat and wood is the worst conductor of heat among the five solid object."

Then identified again to find data from claim by asking the question "what is the reason or evidence that supports it?", an experiment was found. Then warrant was found which connected claim with the data, namely assisted by the question "what is the guarantee to strengthen the evidence and connect the two?" was found in Figure 17.25 which says Different materials conduct heat at different speeds."

In science textbooks published by the Ministry of Education and Culture and Erlangga publications, the C-D argumentation pattern was mostly found at 41.667% and 54.386%. This percentage shows that the majority of science textbooks published by the Ministry of Education and Culture are at level 2 by providing statements accompanied by supporting sentences to prove their truth in the form of data, experiments, observations in daily life, and can also be in the form of pictures that illustrate a situation.

Of the three textbooks that have been analyzed on the topic of heat, there are different numbers of sub-chapters. In the textbook published by the Ministry of Education and Culture there are 4 sub-chapters, the textbook published by Erlangga discusses 16 sub-chapters, and the textbook from Singapore discusses 3 sub-chapters. Actually, the material discussed is not much different, it's just different in the grouping of each sub-chapter. This difference in the number of sub-chapters influences the number of scientific arguments.

Even though in textbooks published by Erlangga there is a very slight difference in the number of C-D-W patterns with textbooks from Singapore, it does not really affect the analysis results because the number of C-D-W patterns of 15 is not comparable to the number of claim found, namely 57. This means that there are more arguments that present statements without supporting sentences to prove their truth and provide statements that are accompanied by supporting sentences to prove their truth in the form of data, experiments, observations in daily life, or in the form of pictures that illustrate a situation compared to providing arguments that provide statements. which is accompanied by supporting sentences to prove its truth in the form of data, experiments, observations in daily life, and pictures that illustrate a situation, and then reinforced by sentences that connect them.

From the analysis results, the C-D pattern is most often found in discussions of the usefulness of the heat concept, so it adapts to the concept presented. This is in accordance with the findings (Wahyuningsih et al., 2020) from the results of book analysis in the argumentation aspect which found many C-D patterns because they adapted to the characteristics of the material. However, the many C-D patterns found in these textbooks can already be said to be an argument because the requirement for an argument is a statement accompanied by evidence and logical reasons with the aim of justifying beliefs, although according to Marhamah et al. (2017) stated that for an argument to be accepted claim requires an explicit warrant.

The following is an example of a comparative analysis of Level 2 Scientific Argumentation Patterns in the 2013 revised edition of the 2013 secondary school science textbook published by the Ministry of Education and Culture and the 2013 revised 2013 integrated science textbook for junior high school curriculum with level 2 scientific argumentation in the textbook Lowe Secondary Science Matters 2nd Volume 2 from Singapore.

The scientific argumentation paragraph in the 2013 revised edition of the revised edition of the 2013 junior high school science textbook, published by the Ministry of Education and Culture, which contains many claim and data elements can be seen on below.

> *You can find convection currents on the beach, in the form of sea breeze and land breeze (claim) during the day. The land heats faster than the ocean (its specific heat is small), the air above the land heats up and moves upward, being replaced by air from the ocean. In this way, sea breeze occurs. (data) Evening. The land cools faster than the ocean, the air above the ocean is warmer and moves up, replaced by air from the land. Thus, a land breeze occurs. (data)* [p. 176]

To carry out an analysis of the availability of the element claim, assisted by the question "what topic is being discussed?", then a sentence is found in the form of a statement that you can find convection currents on the beach, in the form of sea breeze and land breeze. Then, to find out evidence or basic reasons for the existing claim, that is by asking the question "what is the evidence"? From these questions, evidence of claim was found.

The scientific argumentation paragraph in the textbook Lower Secondary Science Matters 2nd Volume 2 from Singapore can be seen on below.

> *When heat is applied to a substance, it increases in volume. We say the substances expand. We call this process expansion. When a substance is cooled, it decreases in volume. We say it contracts. We call this process contaction (claim). When we pour boiling water too quickly into a cup made of thick glass, the glass some times cracks (data). The solid glass on the inside expands more quickly than the outside when heated (warrant).* [p. 142]

To carry out an analysis of the availability of the claim element, assisted by the question "what topic is being discussed?", a sentence was found that stated expansion and contraction in the first paragraph. "What reasons can prove the claim?" Then in the next paragraph, evidence of claim is found in the form of an example of the expansion of a substance. Claim and the data are connected by warrant namely the glass on the inside expands faster than that on the outside when heated. The textbook mostly presents components of scientific argumentation in the form of claim, data, and warrant.

Example of the convection concept. In textbooks from Singapore, the concept of convection in liquids and gases is explained using observations accompanied by pictures that illustrate the occurrence of convection, and are equipped with simple experiments that prove the convection process. Meanwhile, in textbooks published by Erlangga and the Ministry of Education and Culture, the convection process does not provide enough evidence in the form of pictures that illustrate the convection process.

From the analysis activities of science textbooks on the aspect of scientific argumentation, scientific argumentation can be categorized into 4 levels as in Table 2. Based on Table 2, the description of the level of scientific argumentation is categorized into level 1, namely if you give a statement without supporting sentences to prove its truth. An example of a scientific argumentation paragraph that shows level 1 can be seen in the following text.

> *Solids are better conductors of heat than liquids and gases (claim). Liquids and gases transfer heat through convection.* [Example of a Scientific Argumentation in the Level 1]

The text above shows claim but does not explain why solids conduct heat better than liquids and gases. The next sentence just provides different information than claim. This means that there is no evidence in the form of experiments, observations, or images that can support the statement.

Argumentation is categorized into level 2, namely when providing a statement accompanied by supporting sentences to prove its truth in the form of data, experiments,

observations in daily life, and can also be in the form of pictures that illustrate a situation. Examples of scientific arguments categorized into level 2 can be seen in the following text.

> *Land breeze and sea breeze are caused by convection (claim). During the day, the land is hotter than the sea. Hot air rises from the land. The cool sea breeze blows to replace the hot air. (data). Figure 17.46 Sea breeze) Land absorbs heat from the sun and warms more quickly than the sea. The air above the land heats up and rises. The cold, denser air above the water moves to replace the warm air above the land. At night, the opposite happens. The sea stores heat and the land cools more quickly. Land winds blow into the sea. The land loses heat more quickly than the sea and cools more quickly. The air over the sea is now warmer and rises. Cooler, denser water over the land moves to replace the warm air over the sea. (Figure 17.47 Land Wind) (data).* [Example of a Scientific Argumentation in the Level 2]

Based on the scientific arguments above, claim was found which states that land breezes and sea breezes are caused by convection. This statement can be proven true through an explanation supported by pictures illustrating the occurrence of land breezes and sea breezes.

Argumentation is categorized into level 3, namely when providing a statement accompanied by supporting sentences to prove its truth in the form of data, experiments, observations in daily life, and pictures that illustrate a situation, and then reinforced by sentences that connect them. Scientific arguments in the level 3 category can be seen in the following text example.

> *Heat transfer occurs through one or more of the following processes: Conduction, convection, radiation. Conduction is the process of heat transfer through a medium or object without any movement from the medium or object (claim). We can conduct a simple experiment to find out how heat transfers. When the end of a metal rod is heated, the other end will also heat up for a while. (figure 17.3) (data). From this, we can conclude that heat moves from one end of the metal rod to the other end. The transfer of heat through a medium (in this case, a metal rod), without the medium moving, is called conduction (warrant).* [Example of a Scientific Arguments in the Level 3]

From the scientific argumentation text, there is evidence in the form of observations in simple experiments to find out how heat is transferred by conduction. Apart from that, there are pictures that can be used as evidence to describe/illustrate the experiment. Then at the end of the paragraph it is supported by a sentence that connects the experiment with claim namely that heat moves from one end of a metal rod to the other end. Heat transfers through a medium (in this case, a metal rod), without the medium moving.

Argumentation is categorized into level 4, namely when providing a statement accompanied by supporting sentences to prove its truth in the form of data, experiments, observations in daily life, and pictures that illustrate a situation, and reinforced by connecting sentences which are then supported by research results from scientists. Examples of level 4 categories can be seen in the following text.

> *Of course you have put your hand on your forehead when you have a fever. You say "My body is hot", meaning the temperature is high. "However, can you determine the degree of heat by touching your forehead? Likewise, when we dip the tips of our fingers into warm water, the tips of our fingers feel warm. Conversely, when our hands hold ice, our hands will feel cold. How hot is warm water and how cold is ice? (Concept Exploration 4.0. measuring temperature with hands) (Figures a and b) (in the picture measuring temperature with hands (a) put the right hand in ice water and the left hand in warm water, picture (b) put the right and left hands into room temperature water. From this experiment, it turns out that in vessel II your right hand feels warm and your left hand feels cold*

> *(data), when both hands should feel cool. This proves that the hand cannot be used as a temperature measuring tool accurate (warrant). Our hands or sense of touch cannot measure temperature accurately (claim). Scientists have investigated and discovered a temperature measuring device that is precise and standard, in the sense that it can be used internationally, which is called a thermometer (backing).* [Example of a Scientific Arguments in the Level 4]

Based on the text above, it can be seen that claim which states that our hands or sense of touch cannot measure temperature accurately can be proven by a simple experiment which is then strengthened by the connecting sentence data with claim, and supported by scientific findings so that the argument becomes stronger. From the comparison of the density of scientific argumentation from the three textbooks analyzed, the science textbook from Indonesia still does not display the complete pattern of scientific argumentation as evidenced by table 4.2 which shows that the density of scientific argumentation is lower compared to the science textbook from Singapore. So, it is necessary to develop science textbooks in which scientific argumentation is practiced.

From several studies on the development of 2013 Curriculum Middle School science textbooks in Indonesia (Rusilowati et al., 2016) (Wahyuni et al., 2017)); (Hakim, 2019)); (Fitriani, 2019); The direction of textbook development in Indonesia is more towards an integrated model, based on experiments and a scientific attitude. The development of the book does not emphasize aspects of scientific argumentation. In Singapore, several textbook developments are also aimed more at scientific literacy. This is also supported by the research results of Vojir et al (2019) at Charles University in Paha that researchers in Europe and the United States focus more on textbook research, the textbooks that are often researched are science textbooks which mostly consist of analyzing learning concepts and how concepts are integrated. Content, visual representation, and analysis of learning texts do not lead to scientific arguments. One tool for practicing scientific argumentation is through textbooks. According to Redhana & Sudiana, (2017) stated that books designed based on argumentative reasoning patterns can improve students' critical thinking skills. Apart from that, it is important to present material using Toulmin argumentation patterns in textbooks because Toulmin argumentation patterns are suitable for guiding students in logical and critical thinking. This is because Toulmin's six argumentation patterns are related to each other (Wahyuningsih et al., 2020). However, research results show that science textbooks in Indonesia, which are often used in learning, do not facilitate scientific argumentation in them.

Table 4. Description of Scientific Argumentation Levels

Levels	Pattern	Description
1	C	Providing a statement without supporting sentences to prove its truth.
2	C-D	Provide a statement or conclusion accompanied by supporting sentences to prove its truth in the form of data, experiments, observations in daily life, and can also be in the form of pictures that illustrate a situation
3	C-D-W	Provide a statement accompanied by supporting sentences to prove its truth in the form of data, experiments, observations in daily life, and pictures that illustrate a situation, and then strengthen it with sentences that connect it.
4	C-D-W-B	Provide a statement accompanied by supporting sentences to prove its truth in the form of data, experiments, observations in daily life, and pictures that illustrate a situation, and reinforced by connecting sentences which are then supported by research results from scientists.

From the analysis activities of science textbooks on the aspect of scientific argumentation, scientific argumentation can be categorized into 4 levels as in the Table 4. Textbooks from Singapore and from Indonesia that have been analyzed on the topic of heat have different grades or levels, namely the textbook Lower Secondary Science Matters 2 nd Edition Volume B intended for students at the S2E level /S2N or Express/Normal (A) (Approved Textbook List | MOE, 2021). In Indonesia, this book is equivalent to class VIII middle school. This shows that the book can be used in the Express class, namely for students who are smart and can complete 4 years of high school with the condition of passing the "O" level exam. This book can also be used by students in the Normal Academic class, namely students who can complete secondary school in 5 years. In Singapore, the middle class is attended by students aged around 12-16 years or 17 years. The Lower Secondary Science Matters textbook for S2E/S2N level is intended for students aged around 13-14 years. Meanwhile, the two textbooks from Indonesia that were analyzed are aimed at class VII Semester 1 where the students' age is around 12-13 years.

CONCLUSION

The majority of *Lower Secondary Science Matters 2 nd Edition Volume 2* textbooks from Singapore are at level 3 with argumentation criteria consisting of *claim* supported by data and/or *warrant* while the revised edition of the 2013 Class VII Semester 1 Curriculum Middle School Science textbook published by the Ministry of Education and Culture and the Class VII Middle School Integrated Science textbook have the quality of scientific argumentation, the majority of which are at level 2 with argumentation criteria consisting of *claim* which is supported by *data.*

The difference in level of the three textbooks that have been analyzed is that the majority of the *Lower Secondary Science Matters 2nd Edition Volume 2* textbooks are at level 3 because they provide statements accompanied by supporting sentences to prove their truth in the form data, experiments, observations in daily life, and pictures that illustrate a situation, then reinforced by sentences that connect them. Meanwhile, the revised edition of the 2013 Class VII Semester 1 Middle School Science textbook published by the Ministry of Education and Culture and the Class VII Middle School Integrated Science textbook published by Erlangga are mostly at level 2 because they provide statements accompanied by supporting sentences to prove their truth in the form of data, experiments, observations in everyday life, and pictures that illustrate a situation.

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