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# THE CONTRIBUTION OF TOULMIN'S ARGUMENTATION PATTERNS IN PHYSICS LEARNING IN INDONESIA: LITERATURE REVIEW

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***Abstract***

*This research is a descriptive research using literature study method which aims to analyze how far is the contribution of Toulmin's Argument Pattern (TAP) in learning physics in Indonesia. The data collection technique used is a review of articles from previous studies related to the application of Toulmin's argument in learning physics. Sources of data used four articles in this research is secondary data. The data obtained were then analyzed using the, organize method, namely organizing the articles to be reviewed, synthesize, which combines the results of organizing articles into an integrated literature, Identify, which is to identify articles to draw conclusions. Based on the results of the research, it is known that the application of Toulmin's Argumentation in learning Physics in Indonesia has many contributions such as in mastering concepts, problem solving abilities, and especially in improving students' argumentation skills. It is also known that the application of the argumentation-based learning model should be collaborated with problem-based learning models and discussion methods to train students' argument structure preparation. So, for build good argumentation skills, directed teaching is needed by utilizing Toulmin's argumentation pattern.*

***Keywords:*** *Descriptive Research, Literature Review, Toulmin's Argument*

## INTRODUCTION

The education system used today is the 2013 Curriculum which is expected to be able to change education to be more active, creative, and create critical thinking processes and be able to keep up with the times (Pratama & Retnawati, 2018; Beddu, 2019; Dywan, 2020). This is in line with the statement of Azmi et al. (2016) and Sari & Yuniastuti (2018) explaining that a curriculum that can produce Indonesian people who are productive, creative, innovative,

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effective through strengthening attitudes, skills, and knowledge of integrity is the theme of curriculum development 2013. 2013 curriculum makes students the center of learning or student centered learning (Prasetyawati, 2016; Hidayah et al., 2020; Pertiwi et al., 2022). In addition, the 2013 curriculum has also applied 21st century skills through 5M activities (Anwarudin & Admoko, 2019; Pratiwi et al., 2019). The 21st century skills in question are 4C or critical thinking and problem solving, creativity and innovation, communication, collaboration (Fridanianti et al., 2018; Makrus et al., 2018; Septikasari & Frasandy, 2018). While the 5M activity is a scientific approach which consists of observing, asking, trying, analyzing, and communicating (Rhosalia, 2017; Kurniasari & Setyarsih, 2017; Anwarudin & Admoko, 2019).

One of the subjects that uses a scientific approach is physics. In addition, physics lessons are one of the exact science-based learning (Widhi et al., 2021; Herayanti & Habibi, 2015). This is because physics provides an opportunity for humans to be able to understand and interpret the natural environment around them by using the scientific method, knowing, investigating what is not yet known, and explaining something that might happen, and trying to solve the problem (Irvan & Admoko, 2020).

In physics learning, argumentation skills are important. This is in line with the statement of Shandy et al. (2018) and Amiruddin et al. (2022) which states that Physics Learning can ideally lead students to be able to argue or think at a higher level. In addition, scientific argumentation also has a role to help develop the skills needed in the 21st century, namely developing critical thinking skills and effective communication (Bathgate et al., 2015; Faize et al., 2018). Scientific argumentation is a social and dynamic process that involves individuals thinking, constructing, and criticizing knowledge in science (Osborne & Patterson, 2011). Scientific arguments can be weakened, blamed, or verified through the underlying evidence (Riwayani et al., 2019).

The argumentation pattern that is often used is the Toulmin Argumentation pattern. Toulmin's argument has 6 components, namely data, claim, warrant, backing, rebuttal, and qualifier (Toulmin, 2003). The argumentation pattern of students is expected to lead to these 6 components so that the quality of each student's argument can be measured (Erduran et al., 2004). The quality of the argument depends on the understanding of the concept that is owned by a person. Supported by several Toulmin components so that they can construct these components so that they can be convincing and understood by other students (Widhi et al., 2021).

There have been several previous studies regarding the identification and analysis of student arguments. Research conducted by Jewaru et al. (2021) with the title of identifying the quality of scientific argumentation of high school students on thermodynamics obtained the results that students had 46.54 scientific arguments (medium category), and were dominant at level 3 (strong enough). At this level, students are able to write arguments that are quite good or related but less

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scientific. The lowest average of students is at level 2. In addition, the research by Suganda et al (2019) with the title of identification of students' scientific arguments on the topic of sound and light waves obtained the results that students' scientific argumentation on the topic of waves was still low with the average level of students' ability being at levels 1 and 2. A total of 26.31% and 25.19% of the sample have scientific argumentation skills, each aspect of justification and support (Mubarok et al., 2016). In line with this, the results of Putri's research (2018) also explain that the average value of students' scientific arguments is 63.71 out of a score of 100.

Table 1. Argumentation quality

| Level | Criteria |
|---|---|
| 1 | Argumentative sentences are composed of simple claims against the reply or can called a claim against a claim |
| 2 | The argumentative sentence is composed of a claim with good data, warrant or backing, but does not contain an element of rebuttal |
| 3 | The argumentative sentence is composed of a series of claims with good data, warrant or backing with weak rebuttal |
| 4 | The argumentative sentence shows a claim with clearly acceptable rebuttal. The argumentative sentence has several claims and backings, but no argument is needed. |
| 5 | Argumentative sentences are composed of long statements, with more than one rebuttal |

(Source: Erduran et al.,2004)

Based on the explanation above, research is needed on the analysis of the contribution of Toulmin's arguments in learning physics. The purpose of this study is to analyze how far the contribution of Toulmin's argument in physics learning in Indonesia.

## METHODS

This study uses the method of literature study or literature review. According to Neuman (2011), literature review is carried out on the awareness that science is continuously developing and realizes that the research topic has been explored by other researchers. So to get a deeper knowledge conjunction, it can be done by collecting library data or research obtained from various literacy information such as encyclopedias, books and scientific journals (Creswell et al., 2016). The data collection technique used is a review of four articles or journals from previous studies related to the application of Toulmin's argument in physics learning.

Sources of data used in this research is secondary data. The data was obtained based on the above data collection techniques. According to Bennett et al. (2005) secondary data collection techniques were obtained from the following three points.

1. Sorting research articles related to the application of Toulmin's argumentation and limited concept understanding based on publications from 2015 to 2022. Research results that meet the

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criteria will be analyzed more deeply.
2. Identify articles and systematically categorized according to the type of research.
3. Reviewing further by extracting data from articles that meet the criteria for analysis in this study

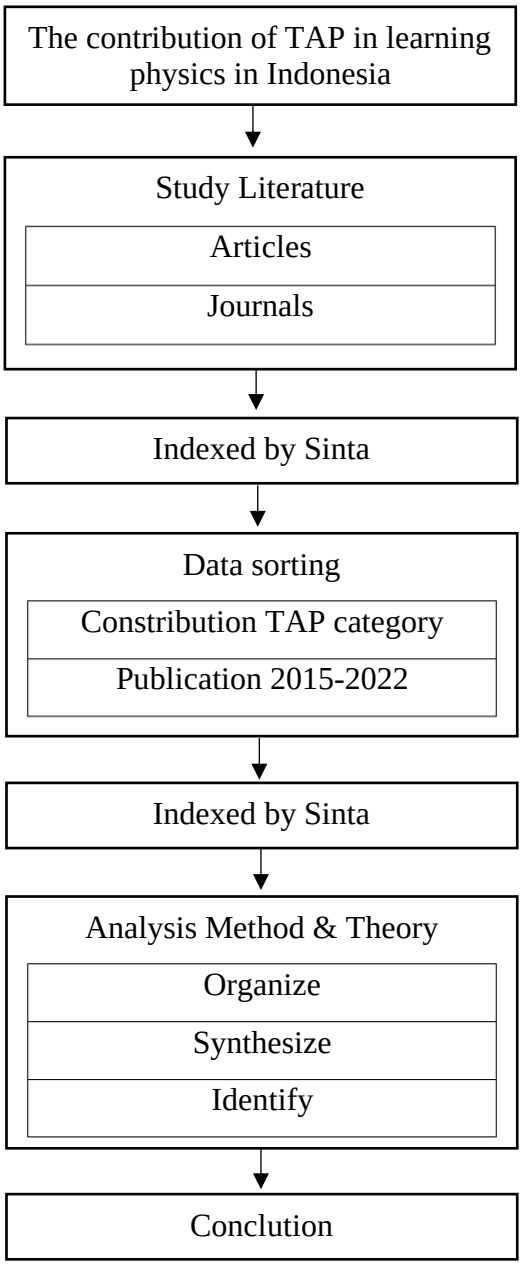


Diagram 1. Flow chart study literature

Exclusion criteria are characteristics of articles that cannot be taken as data (Notoatmodjo, 2018). Exclusion Criteria on this research is,

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1. Article that discusses the aplication Toulmin's argumentation pattern abroad
2. Media development using Toulmin's argumentation.

The data obtained were then analyzed by the method (1) Organize by organizing the articles to be reviewed; (2) Synthesize, which combines the results of organizing articles into an integrated literature; (3) Identify, which is to identify articles to draw conclusions.

In finding the answer to the problem, a schema used which h is illustrated by the following diagram 1.

The article used is an discusses that discusses the contribution of TAP in learning. [1] Analisis Keterampilan Argumentasi Ilmiah Peserta Didik pada Model Pembelajaran Berbasis Toulmin's Argumentation Pattern dalam Memahami Konsep Fisika dengan Metode Library Research (Widhi, M. T. W., Hakim, A. R., Wulansari, N., Solahuddin, M. I., & Admoko, S., 2022). [2] Analisis Kemampuan Argumentasi Ilmiah Siswa pada Materi Optik: Problem-Based Learning berbantuan Edu-media Simulation (Riwayani, R., Perdana, R., Sari, R., Jumadi, J., & Kuswanto, H., 2019). [3] Pengaruh Penggunaan Pola Argumentasi Toulmin pada Pembelajaran Fisika Melalui Metode Diskusi terhadap Peningkatan Pemahaman Konsep dan Kualitas Argumentasi Sains Siswa SMA (Sugandi, S. R., 2015). [4] Using Toulmin's Argument Pattern on Problem Solving Model toImprove Problem-Solving Analysis Ability: Learning Alternatives During the COVID-19 Pandemic (Dwikoranto, 2022).

## RESULTS AND DISCUSSION

### Argumentation

Pattern Toulmin's argumentation pattern or what is often called the Toulmin Argumentation Pattern (TAP) is an adaptation made by Toulmin on the word argumentation. According to Erduran et al. (2004) and Erduran (2018), argumentation is a statement designed to support and prove something in spoken or written form. In this case, Toulmin creates a pattern and conveys it as shown in Figure 1.

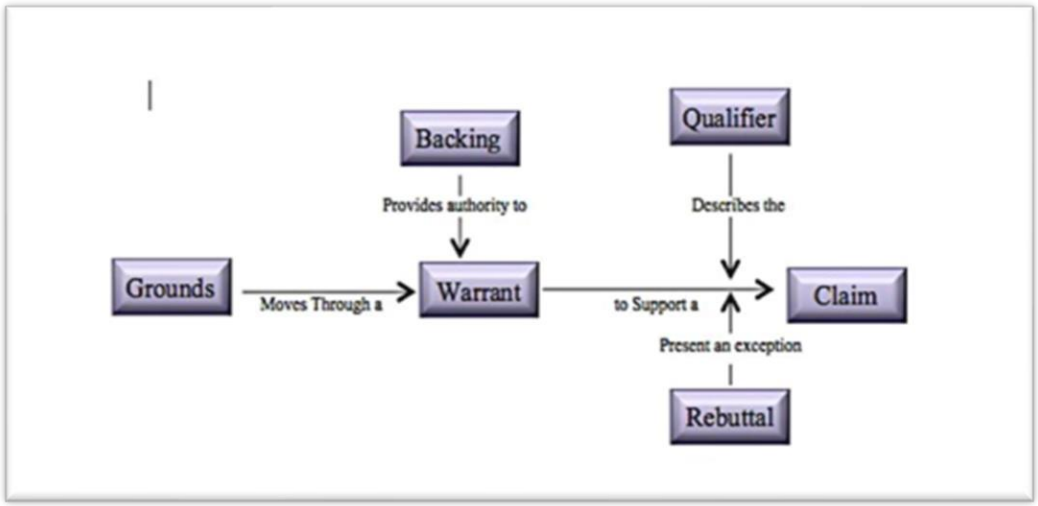


Figure 1. Taoulmin argumentation pattern
(source: Toulmin, 1984)

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Figure 1 shows the argumentation pattern of Toulmin in which there are six components, namely (1) Claim, (2) Grounds/Data, (3) Warrant, (4) Backing, (5) Qualifier, and (6) Rebuttal. Based on these six components, all of them have different functions, but are still interrelated with one another.

1. Claim

Each argument has a purpose, namely to establish a claim (conclusion or thesis). A claim is a disputed/debatable statement - a rhetorical idea (i.e. speaker or writer) asks others to accept. Or also known as a debatable statement. There are three types of persuasive claims; (1) fact claims assert that something is true or untrue, (2) value claims assert that something is good or bad, less or more desirable, and (3) policy claims assert that one course of action is superior to another. Examples of claims can be seen as follows: 'I think learning physics is a very difficult lesson'. Claims state certain positions on controversial and dubious issues. When the other party or opponent rejects a stated claim (especially a complex claim), it is useful to reject the claim by identifying the claim made. Good claims will be debated with good claims also debated so that there will be various supporting data and guarantees.

2. Ground/Data

The arguments that have been expressed or that have been thought out will require evidence, reasons, or what is called the ground (base / data) as the basis for the claim. The premise that has been made is the basis of the deductive argument, while the evidence is the basis of the inductive argument. Examples that can be taken are observations or experiments that can make a possible or permissible claim. Not all claims can be supported by various reasons, because not all reasons provide good support for every claim. The following is an example that can be given regarding ground/data according to Barnet & Beda (2011):

a. I can count all women and men. Let's just say the total is 50 people. If the number of women is 25 and the number of men is 25, then I have been able to defend my claim.
b. I can count at least 10 students, 5 of whom are female students. So I have got the data from the claim.
c. I can point out that students in a class at a university have an equal number of boys and girls and claim that the class can set an example for the whole university.

Based on the example above it can be seen that ground/data (a) is stronger than ground/data (b), and ground/data 2 is stronger than ground/data (c).

3. Warrant

Claims of course need evidence or reasons to support it, so the question will be "why reason does it support this conclusion (claim)?". Warrants can help provide a basis for the formation of claims connecting ground/data and claims. Warrants are general rules for identifying claims' relationships with data. Warrants can be implicit or explicit, but in any case, Warrants are not the same as presidential (the reason is) in other words warrants are rules for giving license inference. Toulmin states that a warrant consists of a specific set of texts that are directly related to the argument being made. An important point that Toulmin makes is that a warrant is a kind of rule inference

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and in particular, it is not a statement of fact

4. Backing

Backing or support or explanation is a supporter of the warrant so that it is not easy to explain related to ground/ data to claims. The hallmark of support is the word 'because' in the argument sentence. Support strengthens every warrant given. Toulmin stated that the difference between backing and data is that backing can be categorized as a statement in its actual form similar to data, while warrants are generalizations (Toulmin, 2003). Backing can also be used as evidence needed in data collection.

5. Qualifiers

The four previous patterns in argumentation can be categorized as follows: claims (defensible conclusions), ground or data (explicitly visible reasons), warrants (principles linking the basis to claims), and backing (implicit assumptions). All of these propositions have a qualifying modality to be presented in a scope and character that is believed to be true.

Is this claim believed to be necessary or perhaps necessary? Is this claim believed to be plausible or could it be plausible? Of the two reasons, both may be good, but may be better than the other. This shows the modality with the proposed statement is very important for the argument or rejection of any argument. Empirical generalizations usually depend on a variety of factors, and it is important to point out these contingencies to protect the public from real examples. So, consider the empirical generalization: qualifications, also called affirmations or conditions, have varying scopes that are just as important as the rest of Toulmin's pattern of argumentation. Quantifiers can be represented by words: only, rarely, often, sometimes, maybe, usually, more or less, and regularly.

6. Rebutal

Rebuttal or also called a rebuttal that is directly related to the existing claim. This rebuttal is the exact opposite of the claim expressed by someone. Disclaimer can be stated by the person who opposes the claim submitted.

Based on the explanation of each of the components above, it can be seen that there are three basic frameworks/components in making an argument, namely (1) Claim, (2) Data, and (3) Warrant (Toulmin, 2003). However, it is better to use these six components so that the arguments made are better and more complex.

**Contribution Toulmin Argumentation Pattern (TAP)**

Argumentation does not only contribute to one field. This can be proven through Figure 2.

Figure 2 shows that arguments can contribute to many things as seen in the image above. On the other hand, it shows that there are four main points that are most closely related to argumentation, namely, scientific literacy, critical thinking, enculturation in scientific culture, and higher orther cognitive processes. In other words, the argument must involve or be supported by these four points in conveying the argument. Through the picture, it can be stated that the argumentation is not arbitrary, but has so much to do with others which require support or rebuttal from the four points above. However, this certainly has a reciprocity, in the sense

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that when the argumentation study is carried out, it will indirectly train the abilities/skills of the four points above. When analyzed more deeply, it turns out that among the four points there are demands for 21st century skills such as scientific literacy, and critical thinking (Indrawati & Wardono, 2019).

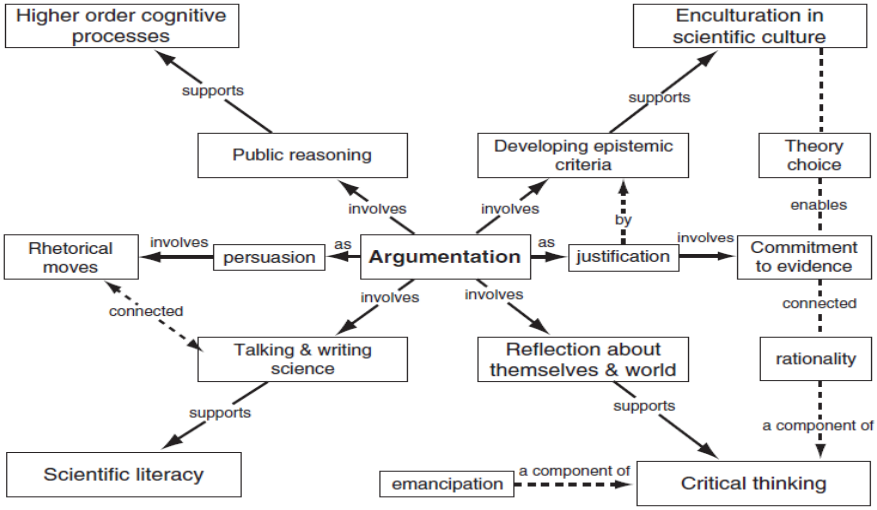


Figure 2. Potential contribution of argumentation
(Source: Erduran, & Jiménez-Aleixandre, 2008).

The position of argumentation is in the middle which states that argumentation is a topic that can be integrated into four main points. In this case, of course the Toulmin Argumentaion Pattern is included. That way, when you want to practice literacy skills, you can use an arguementation approach as well as others. In accordance with the results of research conducted by Kusumastuti et al. (2019) which explains that arguement has a contribution to train critical thinking skills in students' scientific literacy. In addition, based on the results of research from Roviati & Widodo (2019), it is stated that the critical thinking skills of students are strongly supported by the argumentation abilities of the students themselves.

Through the statements described above, it can be said that argumentation contributes to the development of students' critical thinking skills according to the picture above. In addition, the results of research conducted by Paramita et al. (2019) stated that arguement is not only verbal but also social and rational. This is related to one of the four points above, namely, enculturation in scientific culture. Then the last is higher order thinking skills, the relationship with argumentation is explained based on the results of research from Ekanara et al. (2018) which explains that the development of argumentation skills helps students to develop meta-cognition and higher order thinking skills. In this way, it is clear how the relationship between the potential contributions of the argumentation and the argumentation pattern from Toulmin is found.

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**Contribution of Toulmin Argumentation Pattern (TAP) in Physics Learning**

To find out in more detail how TAP contributes to physics learning, it is necessary to review several articles that discuss its application in physics learning so that the information obtained is truly valid.are shown in Table 3.

Table 3. Contribution of TAP in physics learning

| No | Article Title | Author | Result | Recomendation |
|---|---|---|---|---|
| 1 | Analisis Keterampilan Argumentasi Ilmiah Peserta Didik Pada Model Pembelajaran Berbasis *Toulmin's Argumentation Pattern* (TAP) Dalam Memahami Konsep Fisika Dengan Metode Library Research | Widhi, M. T. W., Hakim, A. R., Wulansari, N. I., Solahuddin, M. I., & Admoko, S. (2021) | The results of this study indicate that learning based on *Toulmin's Argument Pattern* (TAP) can improve argumentation skills and understanding concepts, especially in the field of physics subjects. | The hope in the future is that learning using the *Toulmin Argumentation Pattern* can be collaborated on discussion learning, *problem based learning*, and several other learning methods in order to improve students' understanding of concepts, especially in learning physics |
| 2 | Analisis kemampuan argumentasi ilmiah siswa pada materi optik: *Problem-based learning* berbantuan edu-media *simulation* | Riwayani, R., Perdana, R., Sari, R., Jumadi, J., & Kuswanto, H. (2019) | The results showed that PBL assisted by edu-media simulation can improve students' scientific argumentation skills both quantitatively and qualitatively. In this case, students are able to make firm claims by presenting evidence and reasons that support the claims. | For further researchers, it is recommended to focus more on the Toulmin components, namely *rebuttal*, *qualifier*, and *backing*. In this way, it is hoped that the scientific argumentation skills of students will continue to increase and become more complex. |
| 3 | Pengaruh Penggunaan Pola Argumentasi Toulmin Pada Pembelajaran Fisika Melalui Metode Diskusi | Sugandi, S. R. (2015) | The use of Toulmin's argumentation pattern in physics learning through the discussion method can | This study suggests that we continue to develop the Toulmin argumentation pattern because there are still |

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| No | Article Title | Author | Result | Recomendation |
|---|---|---|---|---|
| | Terhadap Peningkatan Pemahaman Konsep Dan Kualitas Argumentasi Sains Siswa SMA | | improve the quality of science argumentation from meeting to meeting in learning activities to become better. This is proven through treatment using experimental mode with a *one group pre-test post-test*. | several levels of argumentation that are still lacking so that it is hoped that in the future more focus will be on the basis of the Toulmin Argumentation Pattern. |
| 4 | Using Toulmin's Argument Pattern on Problem Solving Model to Improve Problem-Solving Analysis Ability: Learning Alternatives During the Covid-19 Pandemic | Dwikoranto, D. (2022) | The results of research conducted on 30 Unesa physics students obtained the results of increasing problem-solving abilities after going through the *onegroup pre-test and post-test design*. In addition, students' responses to the use of Toulmin's argumentation pattern were very good. With the application of the Toulmin argumentation pattern which is integrated into physics learning, it has a good impact on improving students' problem solving abilities | This article suggests the need for research on the number of classes that are more than one and on other study programs at universities in Surabaya. That way, you can know how the *Toulmin argumentation pattern* can work properly. |

Based on the results of the review shown in Table 3, it can be seen that the application of Toulmin's argumentation pattern in physics education has a very positive impact on problem solving skills, concept understanding, and argumentation skills. In addition, in this review there is a learning model used, namely the Problem Based Learning (PBL) model and the discussion model. The two models are student-centered learning

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models that are in accordance with the learning model used in the 2013 curriculum. This provides an opportunity that to practice argumentation it can be done with other models such as inquiry, discovery, and PjBL. However, in its application there are still some shortcomings as described in the suggestion table. On the other hand, TAP's contribution is very helpful for students, students and teachers in developing the skills needed and tested.

## CONCLUSION

Based on previous research, it can be concluded that the application of Toulmin's argumentation in learning physics in Indonesia has many contributions, such as in mastering concepts, problem solving abilities, and especially in improving students' argumentation skills. It is also known that the application of the argumentation-based learning model is best collaborated with the problem-based learning model and the discussion method to train students' argument structure preparation. And to build good argumentation skills, directed teaching is needed by utilizing Toulmin's argumentation pattern. For further research, Toulmin's argumentation can be applied in other subjects such as chemistry, biology, and mathematics.

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