

## TREND TO APPLY TOULMIN ARGUMENT PATTERN (TAP) TO LEARNING PHYSICS IN THE ABILITY TO PRACTICE THE ARGUMENT AND UNDERSTANDING CONCEPTS

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### Abstract

This study was conducted in order to investigate how the argument was positioned in the publication of academic journals in Indonesia and abroad from 2013-2020. The method for the content analysis of this journal is explained using quantitative and qualitative techniques to illustrate the trend of the application of Toulmin Argument Pattern (TAP) on physical learning in training the ability of arguments and understanding of concepts. The type of research implemented is systematic literature review (SLR). The subject of this research is research data in several journals that have been published nationally and internationally. The data analysis techniques in this study are based on the stages of similarity, inequality, giving views, comparing, and summarizing. Based on data derived from published journal results indicating that the use of TAP implementation in physics learning can improve the ability of concepts and comprehension with different outcomes, one of the contributions of this analysis is the illustration that the researchers implementing TAP in physics learning have a positive impact on learners regarding their increasingly better argument ability. It needs to be done for a long time so that the learners are accustomed to making arguments as supporting for scientific investigation activities in emphasizing evidence-based justification for making claims. From the research results can be concluded that TAP can be applied further to learning physics on the material as well as other subjects because it is in accordance with the curriculum developed in Indonesia.

**Keywords:** *Toulmin, physics Learning, Argumentation, Concept Understanding*

### Abstrak

Penelitian ini dilakukan dengan tujuan untuk menyelidiki bagaimana argumentasi telah diposisikan dalam publikasi jurnal akademik di Indonesia maupun luar negeri dari tahun 2013-2020. Metode untuk analisis konten jurnal ini dijelaskan dengan menggunakan teknik kuantitatif dan kualitatif untuk menggambarkan tren penerapan *Toulmin Argument Pattern* (TAP) pada pembelajaran Fisika dalam melatih kemampuan argumentasi dan pemahaman konsep. Jenis penelitian yang dilaksanakan adalah *systematic literature review* (SLR). Subjek penelitian ini adalah data penelitian di beberapa jurnal yang sudah terpublikasi Nasional dan Internasional. Teknik analisis data dalam penelitian ini berdasarkan tahapan yaitu kesamaan, ketidaksamaan, memberikan pandangan, membandingkan, dan meringkas. Berdasarkan data yang diperoleh dari hasil jurnal terpublikasi menunjukkan bahwa penggunaan penerapan TAP dalam pembelajaran Fisika dapat meningkatkan kemampuan argumentasi dan pemahaman konsep dengan cakupan hasil yang berbeda. Salah satu kontribusi dari analisis ini adalah ilustrasi bahwa peneliti yang menerapkan TAP dalam pembelajaran Fisika memberikan dampak positif terhadap peserta didik terkait kemampuan argumentasinya yang semakin baik. Hal tersebut perlu dilakukan dalam jangka waktu yang lama agar peserta didik terbiasa dalam membuat argumentasi sebagai penunjang untuk kegiatan penyelidikan ilmiah dalam menekankan pembenaran berbasis bukti untuk membuat klaim. Dari hasil penelitian dapat disimpulkan bahwa TAP dapat diaplikasikan lebih lanjut pada pembelajaran Fisika pada materi maupun mata pelajaran lain dikarenakan sesuai dengan kurikulum yang dikembangkan di Indonesia.

**Kata Kunci:** *Toulmin, Pembelajaran Fisika, Argumentasi, Pemahaman Konsep*

## **INTRODUCTION**

Phenomena that occur in nature are discussed through in-depth investigation to describe a situation in a structured manner which shows the relationship between scientific findings and existing concepts (Kemendikbud, 2014: 7). The results of scientific discoveries that provide an explanation of this phenomenon are communicated in science lessons conducted by students to understand the environment in depth (BNSP, 2006: 1-2). Science lessons in class are required to be able to support growing each

potential knowledge, skills, and attitudes of students competently that their contributions are needed for humanity (Kemendikbud, 2013: 81A).

The latest program from the Ministry of Education and Culture in 2019 wants all aspects to improve services, especially for movers, which provide the best-supporting facilities for all learning processes to realize superior human resources. The quality of learning in Indonesia when it was still low with the discovery of several studies on the ability to argue the participant students. The results of the 2015 Study for International Student Assessment (PISA) program released by The Organization for Economic Co-operation and Development (OECD) 2015 performance of Indonesian students are still relatively low. Successive averaging a score of achievement of participant learners Indonesia to science, reading, and mathematics is in rank 62, 61, and 63 from 69 countries were evaluated. In the tests that the same year 2018 also showed that the ability to read the participant learners Indonesia gets ranked sixth lowest of the 74 countries in the world with a scoring average was 371. Category Mathematics, Indonesia was rated 7 on the bottom (73) countries with a score on average 379. so also the ability of science of participants learners Indonesia with a score of 389. score the difference of 100 points from an average minimum of 489 points. China occupied the position of the first to score an average of 591.

The results of the 2015 TIMSS were published in December 2016, show results that are not much different, the achievements of participants learners Indonesia fields of Mathematics got rank 46 out of 51 countries with a score of 397. Participants learners Indonesia mastered the routine matter, computing simple, and measuring knowledge will be the fact that contextual daily. Because it is, needs to strengthen the ability to integrate information, give conclusions, as well as the linking of knowledge to matters other (Rahmawati, 2016).

Seeing the condition of Indonesian education and starting from the results of TIMSS and PISA, the government began to make improvements in the field of education. Improved education by changing the

curriculum from KTSP to Curriculum 2013 to answer the challenges of TIMSS and PISA. From surveys were conducted TIMSS and PISA show the level of ability in processing the data to be used as the argument is still relatively low. A low argument is already visible since the participant students were at the level of junior high school, then if not given treatment that is appropriate it will continue on a level that is much higher, namely high school or vocational school and even college high.

Argumentation has an important role in Physics learning activities because it provides an opportunity for students to engage in group discussions and give each other t opinions that indicate the extent of understanding the concepts, skills, and abilities of scientific reasoning (Osborne, 2010). In studying Physics students do an argumentation process, as well as practicing scientific methods when defending or denying ideas (Demircioglu and Ucar, 2012). Argumentation is the process of strengthening a claim through the analysis of the understanding of concepts based on support with evidence and logical reasons (Inch & Warnick, 2006). Through argumentation activities in class, students can solve problems by showing data, as well as evidence in the form of theories to confirm the truth of a claim. Toulmin proposes a scheme that describes the structure of an argument known as Toulmin's Argument Pattern (TAP) (Robertshaw and Campbell, 2013).

Scientific arguments are shown in the main components of TAP, namely the ability of students to make an opinion (claim), find and investigate data, show the truth (warrant), describe support (backing), and provide a rebuttal in every problem. Arguments get special attention in educational research because since ancient times scientists have used arguments to build theories, models, and explanations about every event that occurs in nature (Acar and Patton, 2012; Demirbag and Gunel, 2014; Demircioglu and Ucar, 2012; Diwu, 2010; Erduran, et al., 2006; Robertshaw and Campbell, 2013). The discovery of different evidence in natural knowledge will make each scientist study existing theories continuously to obtain the truth. The development of various socio-scientific problems (socio-scientific) in today's society implies students to be demanded to have the ability to argue scientifically (Robertshaw and Campbell, 2013). Each opinion submitted is based on data, reasons, and scientific evidence that shows the truth of the claim to be accepted by all parties. Regarding these conditions, it is very necessary to train students to have the ability to scientific argumentation.

Findings from Muslim studies et al. (2012) provide evidence that there are new physics teachers who get a change of conceptual understanding and are getting better

after applied to learn Toulmin's argument. Future studies conducted by Chen et al. (Muslim, 2014) provides a description of the ability of the results of students in Taiwan to make connections that explain the interrelationship of data and claims using argumentation patterns concluding that warrant is a key in the argumentation which gives a description of low ability because its meaning is difficult to understand.

Based on the facts that have been revealed, it is necessary to have an appropriate use when learning Physics to improve the ability of argumentation and understanding of concepts simultaneously with the application of the Toulmin Argument Pattern (TAP).

**RESEARCH METHOD**

This type of research is a systematic literature review (SLR). This review is conducted to show the correlation between variables by controlling the variation in the application of physics learning from various journals. Data in the form of secondary sources which are not direct observations from the author. Here, researchers gain more than 30 articles that will be identified much more is needed to get an accurate result.

Retrieval of this data is divided into 3 stages, namely :

1. The selection of published research journals are grouped into 1) TAP was related arguments totalling 28 journals; 2) TAP was related to understanding concepts totalling 7 journals.
2. Describe the research journals to be more systematic by making three categories, based on the results of (the discussion), the year, and the area of the journal concerned.



**Figure 1.** Year of Publication on Indonesian Argument

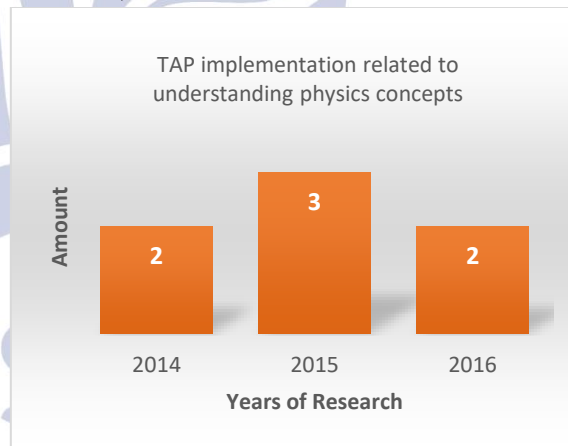
Figure 1 shows a graph of the research argument annually in Indonesia. Sources come from Jurnal Inovasi Pendidikan Fisika (JIPF), Jurnal FKIP Universitas Lampung, Jurnal Penelitian Pendidikan

(JPP) Universitas Pendidikan Indonesia, Jurnal Pendidikan Fisika Indonesia.



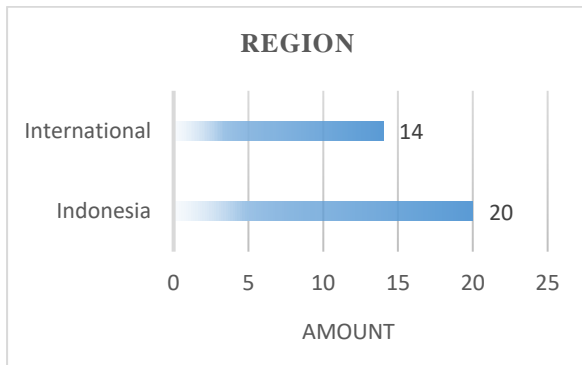
**Figure 2.** Year of Distribution of Journals Related to the Overseas Argument

Figure 2 shows the research graph of the argument at every year in International. Sources come from Australian Journal of Teacher Education, African Journal of Research in MST Education, International Journal of Science Education, Journal Of Geoscience Education, Proceedings of the IConSSE FSM SWCU, European J of Physics Education, Science Education International.



**Figure 3.** Year of Journal Distribution Related to Concept Understanding in Indonesia

Figure 3 shows the number of related journals between arguments and concept understanding in Indonesia. Research on the journal the next year focuses on its argumentation.



**Figure 4.** Journal area related to the argument and concept of understanding

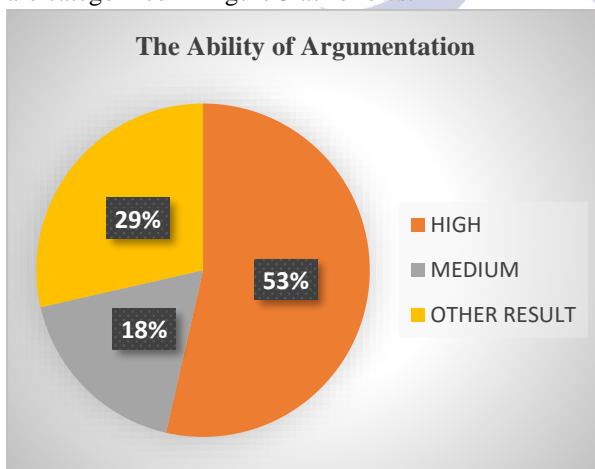
Figure 4 shows the area of research that exists in Indonesia and overseas. As for regional distribution in Indonesia covering the city as Surabaya, Bandung, Malang, Yogyakarta, Banjarmasin, Lampung, Singaraja, Surakarta, Pontianak. Distribution of foreign territories includes Texas (USA), Maine (USA), Miami (USA), İzmit (Turkey), İstanbul (Turkey), Fluminense (Brazil), Orono, Pennsylvania, Missouri (Columbia), Delft (Netherlands), Lesotho (African).

3. Reviewing the contents in depth to be easily understood by the reader.

## RESULTS AND DISCUSSION

### a. Argumentation Ability

The results of 28 studies by experts related to the application of TAP in practicing argumentation skills are categorized in Figure 5 as follows.



**Figure 5.** TAP Implementation Diagram of the Argument's Ability

From Figure 5 above it is reported that the ability of argumentation experienced a high increase of 53 %, medium 18 %, and other results 29 %.

As for some of the journals with the results of the high category as follows this :

- a) Lessons, Naila Zahratul, Nadi Suprpto (2019) provides an overview increase when using a discussion buzz group in learning physics that category height corresponding average n gain of 0.7 with the level of significance  $\alpha = 5\%$ . Based on the quantitative and qualitative model of Toulmin's argument Pattern (TAP), data was obtained at the time of the posttest of 2.1% of learners at level 2, 65.6% at level 3 and 32.3% at level 4. At the time of Pretests 100% of learners are at level 1. Thus there is an increase in the level of argument in writing in all three classes.
- b) Ika Sakti Kurniasari, Woro Setyarsih (2017) gives result the implementation when using Argument-Driven Inquiry (ADI) very well. Having performed a paired t-test that showed that the ability of argumentation participant students already reached level 4 on a claim by 21.9%, to analyze the data of 9.4% by achievements level 4, and rational justification according to the theory only reach level 3.
- c) Gresi Dwiretno, Woro Setyarsih (2018) gives results that indicate that done very well by using a model Argument-Driven Inquiry (ADI). K Capacity of argumentation participant students when tests and performance of its can reach level 3 (grades average 77, 62 ) at Fcount = 1.92 with  $\alpha = 0.05$ .
- d) Hanifah, Setyo Admoko (2019) gave the results that when students do practical work and group discussions that are carried out actively. The ability of argumentation learners who measuring both oral and written were at level 3 and level 4 after the implemented process of learning by ADI.
- e) Siswanto et al (2014) are the argumentation skills of students that have increased in the test class that has used a generator based on scientific methods. However, the experimental class received a more significant contribution than the control class.
- f) Oktapriyadi et al (2016) who apply problem-based learning (PBM) using science shows a high effect result based on effect size with a value of 3.57 for the ability of scientific argumentation of high school students. As for each component of scientific argumentation in sequence (claims, data, justification, and support) with the results of the effect size test

- scores (0.89; 3.13; 3.13; 3.42) indicate a high influence.
- g) Riwayani et al (2019) using PBL assisted with Edu-media simulation showed an increase in students' argumentation ability seen from the results of the t- value test  $-11,051 < -1,711$  which describes the change in the average value of the argumentation from pretest (17) to posttest (47). Because of these results, the students' claims were made firmly by providing evidence and reasons.
  - h) Rachel A et al (2020) show a ninth-grade teacher uses Talk Science to include all four objectives while the seventh-grade teacher does not use it. As a result, ninth graders increase their use of evidence, reasoning, and content, but seventh graders do not show the same improvement. All students appreciate the discussion, but this study shows that the Talk Science discussion can be used to improve students' knowledge and content of argumentation skills.
  - i) Jianlang Wang (2019) Through close observation of a Physics teacher and 23 high school students for 6 months in the competence of scientific knowledge and rhetorical argumentation skills forming the social dynamics of class argumentation, and then the adaptation of practice argumentation. The findings, which suggest beneficial features for the implementation of argumentation, such as the relationship of strong academic competencies and external motivating tasks.
  - j) Omer Acar (2015) shows that middle-level science teachers mostly develop counter-argumentation and rebuttal abilities. Besides, different trends of change in argumentation skills were identified for prospective secondary science teachers who had scientific misconceptions and conceptions. Implications for teacher education and science education are discussed according to these results.
  - k) Omer Pickles & Bruce R. Patton (2016) shows that the use of concrete scientific reasoning is higher than the formal and post-formal term. Besides, they have more than one formal and concrete conception of situational conceptual knowledge before and after instruction. Besides, the reason can score higher than concrete in both the initial and final step achievements. However, a deeper analysis shows that the difference in final achievement between post-formal, formal,

and concrete reasoners is lower than the difference in each other's initial achievement. Implications for teacher education programs have been discussed in accordance with these findings.

One of the results of the medium category in Muslim journals (2015) which results in an increase in the medium category after the implementation of dialogic argumentation learning, so that there is an effect on students' scientific argumentation abilities. The ability of argumentation at the beginning of the initial test obtained a mean of 32.1 while the final test of the mean was 78.8 with the criteria being based on a gain  $\langle g \rangle$  of 0.69. Then journal Diah Rahmawati, Nadi Suprpto (2019) gives the result of an increase in class X MIPA 3 and 4 are at the beginning (31.61; 33.88) into (77.08; 75.69) with an average n-gain 0, 64 and 0.63. Journal Gabriela Azizah, Setyo Admoko (2019) gives the results of the use of discussions class in learning to very good to score an average of two classes for 3,18. Ability arguments in writing that owned the participant students to class X IPA 3 and X IPA 5 which initially level 1 into levels 2 and 3. The results of n-gain with about argumentation and evaluation of the test board, obtained for the ability of argumentation participant learners are in the category being, the class X IPA 3 in sequence, namely 0.668 and 0.631 while class X IPA 5 are 0.539 and 0.681.

As for the other results category journals as follows: Jurnal Adetya et al (2018) found in the field that students' scientific argumentation ability was still relatively low. The quality of students' scientific arguments on average is level 1 (unsupported) and level 2 (phenomenological). The conceptual validity of students' scientific arguments averages at level 1 (invalid). Journal Cem Gurel & Erol Suzuk (2016) shows one of the results of the primary is that PSPTs has a quality that argument low. In addition, this research shows that designing an inquiry-oriented laboratory environment enriched with critical discussion will provide an opportunity for discourse that supports argumentation. Also, PSPTs can be encouraged to support and promote the arguments in the class of Physics future ahead of them if they are involved in inquiry-based argument-lab -oriented.

From the journals that have been found, there is an increase in the ability of argumentation students who apply TAP in learning physics. Improvements in Indonesia use models such as ADI (3), Discussion (3), Guided Inquiry (2), Dialogical Argumentation Instructional Model / DAIM (1), Problem-based learning (2), while for foreign countries still applying

Talk Discussion. This increase occurred after being given treatment for several meetings. Therefore, it is expected to obtain maximum results if it is done in every study over a long period of time.

### b. Concept Understanding Ability

The results of 7 studies by experts related to the application of TAP in practicing the ability to understand concepts are categorized in Figure 6 as follows.

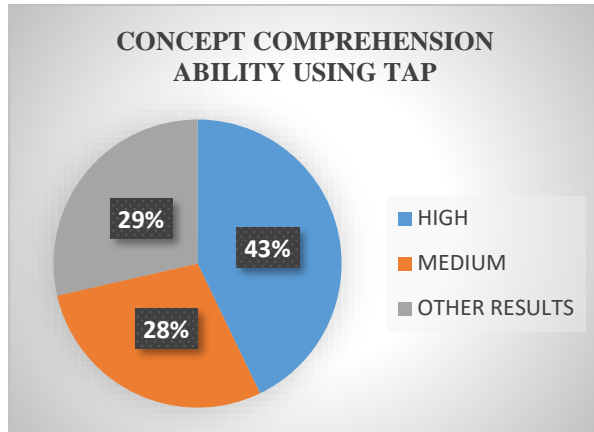


Figure 6. TAP Implementation Diagram on Concept Comprehension Ability

From Figure 6 above it is reported that the ability to understand concepts has a high increase of 43 %, medium 28 %, and other results 29 %.

The journal results in high category that journal Yusiran & Sunarto (2016) which uses the implementation of scientifically based arguments provides an increase in levels of high against the ability of cognitive which is owned by the student. Ability Cognitive is given, understand, apply, analyze, and conduct evaluations. Journals medium category was by Sugandi Sigit Rahman (2015) which applies argumentation Toulmin with discussion gives the effect that positive for the ability to understand the concept of participant learners with the results of the effect size 2,37. The acquisition  $g$  is 0,36 which shows an increase in the ability to understand the categorized concept is moderate. Research other by Nuryandi (2015) resulted in the conclusion that the ability to understand the participant students experienced the rise of the score mean the beginning of 30,16 % became 72.81% with  $n$  gain of 61.36% (Medium). As for the other results category journals by Makomosela Qhobelaa & Eunice Kolutsoe Morub. (2014) that the results indicate that the introduction of the argument as a strategy to introduce the learning approach is centered in the room class science proved to be applied to the development of the concept. Challenges in practice arguments include the use of language second and enculturation of students into the community scientific. Students do part of the

discussion in Sesotho with the language of the local, not the language of English who as a language both are used as a medium of teaching. Students also use the sentence short are required to undertake the elaboration and rarely questioned the justification of the participants other.

From the journals that have been found, there are results in increasing the ability to understand the concepts of students who apply TAP in learning physics. This increase occurred after being given treatment for several meetings. Therefore, it is expected to obtain maximum results if done in each study in a long time span.

### c. Implications of TAP

The implications of applying TAP in learning are 1) accustom students to think critically in responding to a phenomenon by doing argumentation in class, 2) supporting the 2013 revised curriculum which makes students as student centers. In book Sibel Erduran (2007) with the title of Argumentation in Science Education\_Perspectives from Classroom-Based Research explains the potential contribution that can be done from the application of the argument to increase 1) public reasoning to support the higher-level thinking; 2) scientific speaking and writing to support scientific literacy; 3) reflection about self and the world to support critical thinking; 4) the development of epistemic criteria to support the enculturation of scientific culture.

### CONCLUSION

Based on the journals were obtained in national and international publications show the relevance among others: 1) Implementation of TAP in learning physics shows the increase of the ability of argumentation participant students, 2) Implementation of TAP in learning physics shows the increase of the ability to understand the concept of participant students. Another support is still needed to complete the learning process that practices argumentation in the form of argument based practice exercises.

### ACKNOWLEDGMENT

Praise be to the Lord YME, thanks to his love and grace so that the scientific article titled "Trend to Apply Toulmin Argument Pattern (TAP) to Learning Physics in The Ability to Practice The Argument and Understanding Concepts" can be solved well. This scientific article was compiled to complete a series of learning outcomes during the lecture on actual conditions. Success in the preparation of this article is not escaped from all parties who have helped, guided, and provide support directly or indirectly, therefore the author expressed a thank you to:

1. Prof. Dr. Madlazim, M.Si and Dra. Suliyanah, M.Si. as the lecturer of research proposal examiner who has given a lot of advice and guidance.
2. Nadi Suprpto, Ph.D as Secretary of Physics Department of the State University of Surabaya which facilitates in the recruitment of thesis course.
3. Both parents, family, and friends always give motivation and passion in completing this scientific article.

The author realizes that this article is far from perfection, therefore the criticism of the suggestion that builds from various parties is very much the author expects for future improvements. Amin Ya Rabbal'amin.

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