ANALYSIS OF THE EFFECTIVENESS OF ARGUMENTATION LEARNING MODELS FOR INCREASING STUDENTS' ARGUMENTATION SKILLS BASED ON SCORING MATRIX LEVELS OF TOULMIN'S ARGUMENTATION PATTERN (TAP) IN PHYSICS LEARNING

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Abstract

This study aims to determine the effectiveness of learning models in improving students' argumentation skills. This effectiveness is in the form of increasing the level of argumentation of students from before applying the learning model until after the learning model is applied. The type of research used is library research, that is research in which data or research objects are obtained through various library information such as journals, books, encyclopedias, and similar literature. The data source used by this research is secondary data. This research data analysis method is a descriptive analysis method, which is the decomposition of data obtained regularly and then given an understanding and explanation so that the reader can understand the contents of the data obtained properly. Based on the results of the study, it was found that the average argumentation skill of students using the scoring matrix Toulmin's Argumentation Pattern before applying the learning model was at level 1-2. After applying learning and re-measuring the skill of argumentation shows level 3-4 although in one learning model still shows level 2. Two learning models are best to be applied to improving students' argumentation skills. First the inquiry model with the Argument Based Science Inquiry (ABSI) learning model with an increase of 2 levels after learning is applied with a high n-gain value category. Second, Argument-Driven Inquiry (ADI) with an increase of 2 levels after applying learning with a moderate n-gain value category. Both of these models can improve students' argumentation skill to level 4 where after learning the students can formulate arguments accompanied by a conditional rebuttal and the rebuttal begins to be seen.

Keywords: argumentation, models, levels.

Abstrak

Penelitian ini bertujuan untuk mengetahui efektifitas model-model pembelajaran dalam meningkatkan kemampuan argumentasi peserta didik. Efektifitas ini berupa peningkatan level argumentasi peserta didik dari sebelum diterapkan model pembelajaran sampai setelah diterapkan model pembelajaran. Jenis penelitian yang digunakan adalah penelitian kepustakaan, yaitu penelitian yang data atau objek penelitiannya diperoleh melalui berbagai informasi kepustakaan seperti jurnal, buku, ensiklopedia, dan kepustakaan sejenis. Sumber data yang digunakan oleh penelitian ini adalah data sekunder. Metode analisis data penelitian ini adalah metode analisis deskriptif, yaitu penguraian data yang diperoleh secara teratur kemudian diberikan pemahaman dan penjelasan agar pembaca mampu memahami isi dari data yang diperoleh dengan baik. Berdasarkan hasil penelitian diperoleh bahwa rata-rata kemampuan argumentasi peserta didik menggunakan matriks penskoran *Toulmin's Argumentation Pattern* sebelum diterapkan model pembelajaran berada pada level 1-2. Setelah diterapkan pembelajaran dan diukur kembali kemampuan argumentasinya menunjukkan level 3-4 meskipun pada satu model pembelajaran masih menunjukkan level 2. Terdapat dua model pembelajaran yang paling baik untuk diterapkan dalam meningkatkan kemampuan argumentasi peserta didik. Pertama model *inquiry* dengan model pembelajaran *Argument Based Science Inquiry* (ABSI) dengan peningkatan 2 level setelah diterapkan pembelajaran dengan kategori nilai *n-gain* tinggi. Kedua *Argument-Driven Inquiry* (ADI) dengan peningkatan 2 level setelah diterapkan pembelajaran dengan kategori nilai *n-gain* sedang. Kedua model tersebut mampu meningkatkan kemampuan argumentasi peserta didik hingga level 4 dimana setelah diterapkan pembelajaran peserta didik mampu menyusun argumen dengan disertai sanggahan yang bersifat kondisional dan sanggahan mulai terlihat jelas.

Kata kunci: argumentasi, model, level.

INTRODUCTION

In this 21st century, a person is required to have skills in various things, one of which is to be able to communicate a matter orally or in writing and have curiosity and imagination (Wagner, 2010) (NRC, 2011). Permendikbud number 54 of 2013 concerning graduates competency standards also requires students to have

thinking skills as a condition of graduation. Because of this demand, education is now expected to be able to practice skills that are a common need in this century (Ince, 2018). Education is expected to be used to support the development of human resources, especially students who are prepared to become successful and independent individuals in life (Suwandi, Tawil, and Amien, 2013).

Based on the results of the Program for International Student Assessment (PISA), which is held every 3 years to measure the learning competencies of students globally. Achievement of students in science in the last 3 periods (2012, 2015 and 2018) shows that Indonesia's score is still below the average international score. In 2012, Indonesia ranked 64th out of 65 countries, which ranked 2nd lowest (OECD, 2012). In the field of science scored 382 out of 501 scores. In 2015 Indonesia was ranked 64th out of 72 countries, ranking 8th lowest. In this case, the score is 403 out of 493 scores (OECD, 2015). In 2018 Indonesia dropped dramatically to 74th out of 79 countries, getting a score of 396 out of 489 scores (OECD, 2018).

The PISA framework is based on three scientific competencies that are characterized as the skill to (1) identify problems and scientific questions and can provide answers based on scientific data, (2) explain or predict phenomena by applying appropriate scientific knowledge, and (3) using scientific evidence to draw conclusions, communicate and identify assumptions, data, and reasons behind conclusions (OECD, 2006). Based on the PISA framework above, it seems clear that the framework used is the argumentation framework.

This is also supported by the findings of Sondang (2012) and Muslim (2012) who find that the argumentation skill of students on average is still very low. Based on the results of the PISA three periods and the findings above show that the argumentation skill of students in Indonesia is still very low this is what makes argumentation very important taught for students to support thinking skills, skills to develop knowledge and be able to communicate a matter orally or in writing.

The argument itself is a process of strengthening claims based on data and logical and objective reasons through the analysis of critical thinking to be accepted as truth (Erduran et al., 2004). As stated by Toulmin (2003) regarding Toulmin's Argumentation Pattern (TAP), there are six components of scientific argumentation, namely data, claims, warrant, backing, qualification, and rebuttal. However, according to McNeill (2016), someone has been said to argue if it has raised 3 components of the argumentation, namely claim, data, and warrant.

In measuring the skill of argumentation, Toulmin's argumentation can be used. This is in line with the results research of Erduran, Simon, and Osborne (2004). They show that there is a matching pattern of Toulmin's

arguments used by researchers in identifying arguments and measuring the level of argumentation. The assessment techniques used for students' argumentation skills are based on written assessments whose scoring is finally given a level according to the table below.

Table 1. Argument scoring matrices adapted from Toulmin's Argumentation Pattern

Level	Description	TAP component
1	Able to provide a scientific statement with evidence.	Claim
2	Being able to clarify claims by providing data or scientific evidence.	Claim and data.
3	The argument shows the relationship between data and claims, perhaps also accompanied by a rebuttal but very weak.	Claim, data, warrant, and backing.
4	The argument shows that there is a conditional rebuttal that is starting to be seen clearly.	Claim, data, warrant, backing, and qualifier.
5	A very strong argument is shown with a clear rebuttal and maybe more than one.	Claim, data, warrant, backing, qualifier, and rebuttal.

(Source : Lee, et al. 2014)

Good argumentation skills certainly do not escape the good learning process as well. The learning model strongly supports the success of the learning process (Asril, 2011). At present, there are many studies integrating arguments into learning models. Each researcher tries to convey physics learning effectively (Suprapto, 2012). However, not all learning models are effective in improving students' argumentation skills. The learning model itself according to Isjoni (2012: 147) is a process of increasing attitudes and learning motivation so that students can think critically, have social skills, and have more achievement in learning outcomes.

Based on the description above, the researcher intends to research to know the effectiveness of learning models in improving students' argumentation skills. This effectiveness is in the form of increasing the level of argumentation of students from before applying the learning model until after the learning model is applied.

METHOD

The type of research used is library research, namely research in which data or research objects are obtained through various library information such as journals, books, encyclopedias, and similar literature (Syaodih, 2009). Literature research itself begins by reviewing and critically reviewing findings in the form of ideas or knowledge in academic-oriented literature (Cooper and Taylor in Farisi, 2010).

The purpose of library research is to find a variety of knowledge that is used to solve the formulated problems (Mustika, 2004). The data analysis method of this research is descriptive, namely the decomposition of data obtained regularly and then given an understanding and explanation so that the reader can understand the contents of the data obtained well (Winarno, 1990).

The data source used by this research is secondary data. Secondary data is data obtained from the results of previous studies (Arief, 1992). Secondary data referred to here are articles that have been selected based on certain categories. Retrieval of this data is divided into 3 stages, namely:

1. Selection of research articles related to the argumentation to be analyzed: Selection of criteria for articles to be analyzed. Here researchers search for literature through various media and make selections based on the criteria obtained.

Here researchers get more than 30 articles that will be further identified needed to get accurate results.

2. Identifying articles and making a more systematic category: from some of the articles obtained, further categorization is carried out, here the researcher makes 3 categories, namely based on the learning model, the year of the article, and the article area.

**Table 2.** Distribution of articles based on learning models

Argument Learning Model	Total Articles
Argument-Driven Inquiry (ADI)	4
Discussion Learning	3
Discovery Learning	1
Inquiry Learning	4
Problem Based Learning	2
Case Based Learning	1

After obtaining these categories, the number of articles that passed the selection amounted to 10 articles which will be reviewed in more depth. The categories are (1) based on the argument-based learning model listed in Table 2., (2) based on the year of the article that is the

year used refers to the last 5 years article, 2015-2019 whose distribution is shown in Figure 1. and (3) based on the region, namely the territory of Indonesia whose distribution is shown in Figure 2.
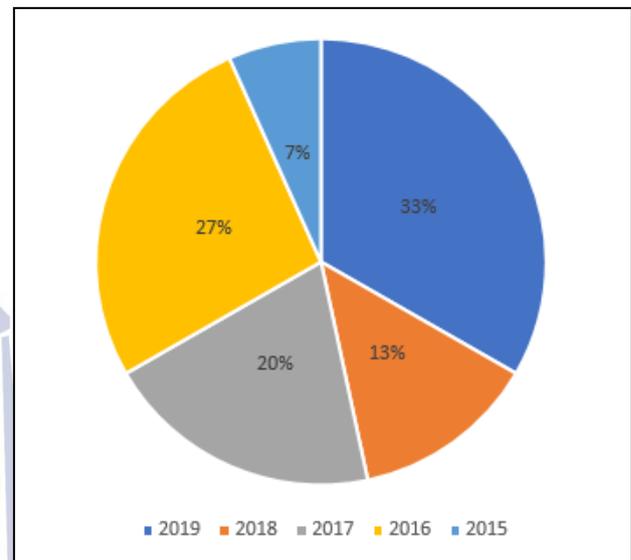
Figure 1. Distribution by year
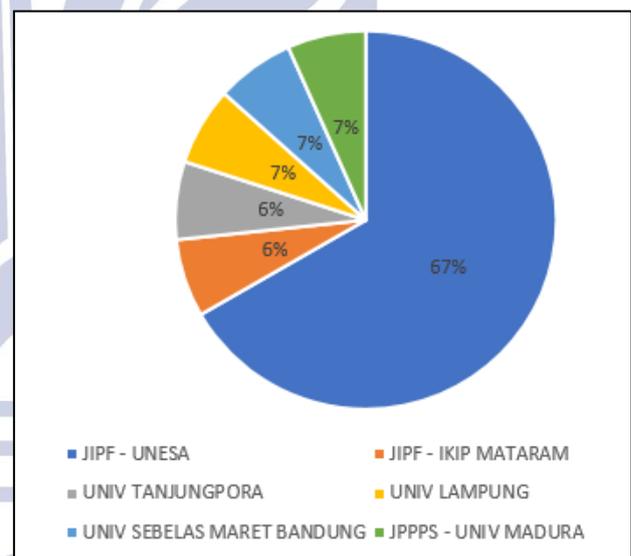
Figure 2. Distribution by article area

3. Review and extract data related articles: after the article has been selected, articles that pass the selection are read and studied its contents, then reviewed and interpreted data so that the reader easily understands it.

RESULTS AND DISCUSSION
Argument-Driven Inquiry (ADI) Learning Model

In learning with the ADI model by reviewing 4 related articles, namely an article by Kurniasari (2017) entitled "*Penerapan Model Pembelajaran* Argument Driven Inquiry *(ADI) untuk Melatihkan Kemampuan*

Argumentasi Ilmiah Peserta Didik pada Materi Usaha dan Energi", Dwiretno (2018) entitled "*Pembelajaran Fisika Menggunakan Model* Argument Driven Inquiry *(ADI) Untuk Melatihkan Kemampuan Argumentasi Ilmiah Peserta Didik*", Hanifah (2019) entitled "*Penerapan Model Pembelajaran* Argument Driven Inquiry *(ADI) Untuk Melatihkan Kemampuan Argumentasi Ilmiah Peserta Didik SMA*", and Suliyanah (2019) entitled "The Process of Developing Students' Scientific Argumentation Skill Using Argument-Driven Inquiry (ADI) Model in Senior High School on The Topic of Elasticity". The average researcher gets the results of the pretest at level 1 and 2, namely, the argumentation is well structured, but does not explain the relationship between claims and data. Then when the posttest the researcher found that some students could reach level 4 and the average level reached 3.

The implementation of learning in research conducted by Kurniasari (2017) gets a score ranging from 3-4 (a maximum score of 4), which means that the argumentation learning with the ADI model is carried out as planned. The activities of the students also ranged in numbers 3-4 (maximum score of 4) which means that the activities of the students in the study were carried out as planned.

The implementation of learning in research conducted by Dwiretno (2018) gets a score ranging from 3-4 (maximum score of 4), which means that the learning carried out is done well. Student activities are also good because they have a score of 3 (maximum score of 4), which means that the activities of students are carried out as planned.

In Hanifah's research (2019), the feasibility of learning can be seen from the active students doing practical work and group discussions. This study also measures the level of oral argumentation of students and the measured oral argumentation is at level 3 while in written argumentation some students can reach level 4 after learning is implemented. This is following the research of Demircioglu and Ucar (2015: 279) which says that students tend to express their arguments in writing rather than verbally.

In Suliyanah's (2019) research, the feasibility of learning can be seen from the activeness of students in answering questions raised by teachers. The teacher also trains students to argue verbally to develop their argumentative abilities and it seems that their students' argumentation abilities have gradually increased from level 1 to level 3.

Discussion Learning Model

In learning with the Discussion model by reviewing 3 related articles, namely the article by Hikmah (2019)

entitled "*Penerapan Model Pembelajaran Diskusi Kelas Tipe* Buzz Group *Untuk Meningkatkan Kemampuan Argumentasi Ilmiah Peserta Didik Kelas X MIA Materi Usaha Dan Energi*", Anwarudin (2019) entitled "*Penerapan Model Pembelajaran Diskusi Kelas Untuk Meningkatkan Argumentasi Ilmiah Materi Getaran Harmonis*", and Fenditasari (2016) entitled "*Penerapan Model Pembelajaran Diskusi Kelas Untuk Meningkatkan Kemampuan Argumentasi Ilmiah Siswa Kelas XI SMA Negeri 18 Surabaya Pada Materi Fluida Dinamik*". The average researcher gets the results of a pretest at level 1, that is, the argumentation only consists of limited claims and not possible data that does not explain the claim. Then after applying learning to the discussion model, researchers get an average of students' argumentation skills reaching level 3, that is, argumentation is well structured, has a relationship between claims and data, clear warrant and backing, and has a very weak rebuttal.

In a study conducted by Hikmah (2019), there were several obstacles during learning, including students who were busy preparing for the art performance competition the next day so that this was what made their concentration divided and the length of the discussion process that made the time for practice questions reduced. This slightly affected the posttest results during the study, namely from 93 students 2.10% were at level 2, 65.60% at level 3, and 32.30% were at level 4.

In the research conducted by Anwarudin (2019), using 2 classes. The results of the pretest in both classes are at level 2, but the number of students is different. Then after applying the learning model, the results of the posttest in the first and second grades are at the same level that is level 3. 75.00% of the students on first-class reach level 3 while 11.11% of the students on second class reach level 3. Based on the results of the pretest and posttest there is an increase in students' scientific arguments. Based on the results of the students' activities, the activities of the students are carried out as desired. This means that the application of the discussion model can improve students' scientific argumentation skills.

In a study conducted by Fenditasari (2016) using 3 classes. The implementation of learning is at an average score of 85.00% so that it can be said the learning is carried out as planned. At the time of the pretest, students were only able to reach level 1 but at the posttest, students were able to reach level 3 with an average score of n-gain is 0.66 with the moderate category.

Discovery Learning Model

In the discovery learning model by reviewing 1 related article that is an article by Rahmawati (2019) entitled "*Pengaruh Pembelajaran* Guided Discovery *Terhadap Keterampilan Argumentasi Tertulis Peserta*

Didik SMA" which was conducted in two classes. At the time of the pretest, the students in both classes were only able to reach level 1 to 3 then after being given learning the average posttest students in both classes were able to reach level 4. In testing the hypothesis was given a test to find out the increase in the skill of his argumentation with the n-gain test in the first class the large value of n-gain is 0.64 with the medium category and the second class of large n-gain values is 0.63 with the medium category so that it can be said to be a students' argumentation skills are increased.

Table 3. Analysis of N-Gain in Each Class of Discovery Learning Model.

Class	N-Gain	Category
First Class	0,64	Medium
Second Class	0,63	Medium

Inquiry Learning Model

In the inquiry learning model by reviewing 4 related articles namely an article by Hendratmoko (2016) entitled "Development of Physics Learning Materials Based On Guided Inquiry Model Integrated With Virtual Laboratory To Facilitate Student's Scientific Argumentation Ability", Budiyono (2016) entitled "*Pengaruh Penerapan Model Pembelajaran* Argument Based Science Inquiry *(ABSI) Terhadap Peningkatan Kemampuan Berargumentasi Siswa SMA*", Sandhy (2018) entitled "*Pengaruh Model Inkuiri Untuk Meningkatkan Keterampilan Argumentasi Peserta Didik Terhadap Materi Getaran dan Gelombang*", and Aisyah (2015) entitled "*Penerapan Model Pembelajaran Inkuiri untuk Melatihkan Kemampuan Argumentasi Ilmiah Siswa pada Materi Kalor di SMAN 1 Pacet*". The average student pretest results from the study only reached level 1-2. Then after the inquiry learning model is applied, the students' argumentation skills rises at level 3-4.

In this study conducted by Hendratmoko (2016) this used 3 classes. The implementation of learning to start from the introduction, core, and closing is done very well. This shows that the teacher can allocate time well so as to create a learning atmosphere in accordance with what is planned. Increasing the level of argumentation is at level 1 at pretest and level 3 at the posttest. Analysis of the increase in argumentation is measured using n-gain, namely in the first class with an average score of n-gain of 0.56 and in the medium category, the second class with an average score of n-gain of 0.49 and in the medium category, and the third class with an average score of n-gain of 0.55 and in the medium category. This shows that guided inquiry learning influences the students' argumentation skills.

Table 4. Analysis of N-Gain in Each Class of Hendratmoko's (2016) Research.

Class	N-Gain	Category
First Class	0,56	Medium
Second Class	0,49	Medium
Third Class	0,55	Medium

In a study conducted by Budiyono (2016) according to the results of the pretest and posttest using a matter of description of the material elasticity whose indicators refer to the pattern of argumentation. By analyzing the pretest and posttest scores as well as from the indicators provided, the initial argumentation level of learners is at level 1-2 during the pretest and is at level 3-4 at the posttest with the average being at level 4. Analysis of increasing argumentation is measured also using n-gain is 0.85 with the high category. This shows the Argument Based Science Inquiry (ABSI) learning model has a high influence on the skill of students' argumentation.

In a study conducted by Sandhy (2018) by analyzing the results of the pretest and posttest, the students' initial argumentation skills were at level 1 and at level 3 after the learning model was applied. The percentage of the implementation of learning done has a value of 87.5% which means the learning is done well according to what is planned by the teacher. Increasing the skill of argumentation is analyzed using the n-gain value of 0.44 in the medium category. This shows that guided inquiry learning influences the students' argumentation skill.

In a study conducted by Aisyah (2015) by analyzing the results of pretest and posttest students' initial argumentation ability was at level 1 and after learning was implemented, there was an increase to level 3. Increased argumentation ability was analyzed using n-gain values with an average value is 0, 42 with the medium category. The implementation of learning can be said to be carried out as planned by researchers with a score of 3.36 (maximum score of 4).

Problem Based Learning Model

In the model of problem-based learning by reviewing 2 related article namely an article by Agusni (2017) entitled "*Pengaruh Skill Argumentasi Menggunakan Model* Problem Based Learning *Terhadap Hasil Belajar Siswa*" and Mubarok (2016) entitled "*Pengaruh Model Pembelajaran Berbasis Masalah Dengan Pendekatan Saintifik Terhadap Kemampuan Argumentasi Ilmiah Siswa SMA Pada Materi Pengukuran*". The average pretest results of students only reached level 1. Then after applying the problem-based learning model, the students' argumentation ability increased to level 2 in Agusni (2017) research and level 3

in Mubarok's research (2016). Students have been able to provide and clarify claims by providing data and scientific evidence. Student's argumentation skill data is obtained by giving written tests with scoring guides adapted from Toulmin's Argumentation Pattern (TAP).

The implementation of learning from the two articles is categorized as very good which can be said that learning is carried out as planned. There are no obstacles when researchers take research data.

Case Based Learning Model

In the case-based learning model by reviewing 1 related article, namely an article by Amaliah (2019) entitled "*Keterlaksanaan Model* Case-Based Learning (CBL) *Untuk Meningkatkan Keterampilan Agrumentasi Peserta Didik Kelas X Madrasah Aliyah Bilingual Krian*", the average pretest results obtained by students only reached level 1. Then after the case-based learning model was applied, the students' argumentation ability raise to level 3. The implementation of the learning got a percentage of 91.40% which meant that the learning was done very well and as planned. Researchers have several obstacles when students answer questions about argumentation, namely when learning, students are not accustomed to arguing about complex cases because the learning used so far direct instruction model, so they need to adapt to the questions of the argument given.

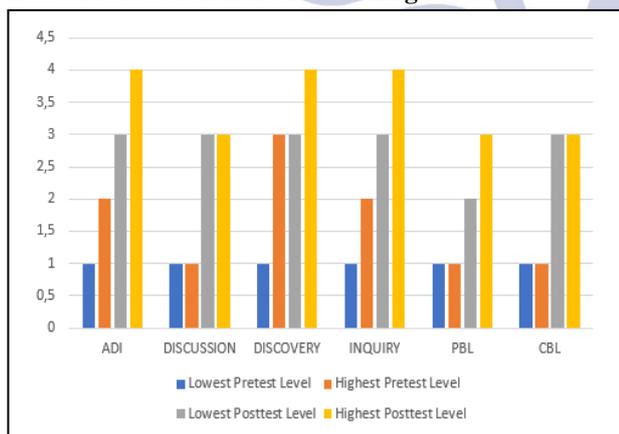**Level Distribution in Each Learning Model**

Figure 3. Distribution of the pretest and posttest levels of each learning model

After the data presented above, the level distribution of each argument learning model is obtained according to Figure 3. From the distribution of students' argumentation level using the Argument-Driven Inquiry (ADI) learning model, Discovery Learning, and Inquiry Learning, students can reach level 4 in their argumentation skills after the learning model is applied. The lowest score is in the Problem Based Learning (PBL) model which only

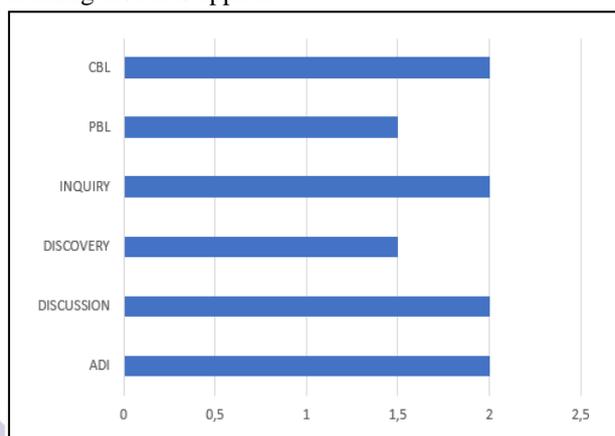reaches level 2 for students' argumentation skills after the learning model is applied.

Figure 4. Increasing the level of argumentation skill in each learning model

Then from the distribution level above obtained an increase in the level of argumentation skill in each argument learning model according to Figure 4. The highest level of argumentation increase is found in the Argument-Driven Inquiry (ADI), Discussion, and Inquiry learning model, which is two levels and the lowest in the Problem Based Learning (PBL) learning model, which is equal to one level.

CONCLUSION

Each learning model has advantages and disadvantages of each. In the Argument-Driven Inquiry (ADI) and Argument-Based Science Inquiry (ABSI) learning models, the learning was explicitly intent to improve students' argumentation skills. In the Inquiry and Discovery learning model, students are more emphasis on understanding the concept were learning on students centred. In the discussion learning model, students are an emphasis on practising the thought process and expressing opinions accepting differences of opinion and uniting those differences of opinion. In the Problem Based Learning model students emphasize the skill to solve problems using a scientific thinking approach. In the Case-Based Learning model students emphasize the ability to solve problems based on cases given by the teacher during learning. Researchers are still searching for good argumentation learning models by use models that are integrated with Toulmin's argumentation approach.

Based on the data and data analysis above, it can be concluded that two learning models are best used to improve students' argumentation skills. First, the Inquiry learning model but in the Argument Based Science Inquiry (ABSI) model with an increase of 2 levels with the highest level of 4 and the results of the study obtained n-gain results with a high category. Both learning models

Argument-Driven Inquiry (ADI) with an increase of 2 levels with the highest level 4 and the results of the study obtained n-gain results in the medium category. According to Dwiretno (2018), the ADI learning model is a learning model that has 8 syntaxes, therefore it is recommended that teachers be able to prepare and plan a good time allocation during learning so that the argumentation process in learning can be carried out well.

The difference between the two models with the other models is the existence of practicum in the Argument-Driven Inquiry (ADI) and Argument Based Science Inquiry (ABSI) Models. Physics learning itself includes conceptual learning, where students must be involved in laboratory activities to understand their knowledge appropriately. This is in line with the statement of Duran (2014), where practicum activities in the laboratory will provide experience to students directly.

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