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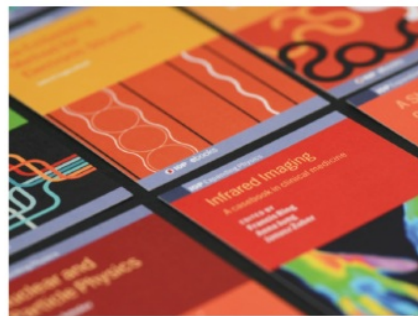
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Promoting students' argumentation skill through development science teaching materials based on guided inquiry models

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Promoting students' argumentation skill through development science teaching materials based on guided inquiry models

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Abstract. Argumentation skills are an important practice in science in the 21st century to develop analytic skills and engage in arguments that can construct scientific explanations, develop critical thinking skills and evaluate alternatives. Science learning with guided inquiry model is able to facilitate students in learning to argue. However, good learning must be supported by good teaching materials. So the purpose of this research is to develop junior high school science teaching materials to improve students' argumentation skills. This research uses the Research and Development (R & D) method which was adapted from Borg & Gall. The parameters used to determine the quality of teaching materials developed are validity and practicality. The validity and practicality of the teaching materials developed were analyzed using Aiken's V. The results of the feasibility test based on the results of expert validation were obtained by Aiken's V of 0.75 with valid criteria, while the practicality test results based on teacher and student responses obtained Aiken's V scores in a row 0.84 (very practical) and 0.80 (practical). In addition, the developed teaching material includes indicators to promoting students' argumentation skills such as claims, evidence, reasoning, and rebuttal. In conclusion, the teaching materials developed includes the criteria for developing quality products that are valid and practical.

1. Introduction

The paradigm shift in the 21st century from the use of the behavioristic approach to being constructivist and the application of the 2013 curriculum at every level of education, requires the use of teaching materials and learning devices, as well as strategies or learning models that can develop Higher Order Thinking Skills (HOTS) students' in the learning process [1,2]. The government has provided science teaching materials in the form of K-13 teaching books to be applied at every level of education to train students develop HOTS. However, the applied K-13 science teaching book does not provide good learning models and methods. This causes learning to be monotonous because teachers will be more likely to teach using the models and teaching methods they like without considering the suitability of the material and character of the students. In addition, the textbook is still oriented towards material content and is seen to lack training in HOTS, especially students' argumentation skill. The same as books sourced from publishers.

The results of a previous survey by TIMMS (Trends in International Mathematics and Science Study) and PIRLS (Progress in International Reading Literacy Study) showed reasoning ability or giving reasons as many as 40% of students were in the low category and as many as 60% of Indonesian learners reached the low category. Most of the arguments of students in the form of statements that contain a little supporting reasons [3,4]. Students have problems connecting data to support their arguments [5].

Argumentation skills was still less trained in science learning [6]. The observation results also found that students still tend to assume that science lessons are difficult to understand, and students are less trained to learn independently so can't to present their arguments scientifically. This causes the science learning outcomes of junior high school students in Mataram on average less than or equal to the Minimum achieved Criteria (KKM), which is 75. Previous research shows that based on the theory of complete learning, a student is considered to have finished learning if he is able to complete, mastery competencies or achieve learning objectives at least 65% of all learning goals. Meanwhile, the class was said to have succeeded in achieving completeness if at least 85% of the total number of students in the class had achieved individual completeness [7].

The ability of students to master the concept can be seen from the learning outcomes [8,9]. Meanwhile, the level of students' argumentation skill is influenced by the ability of these students in mastering the concept of learning. The scientific arguments can be used to improve students' understanding of scientific concepts. The students' argumentation skill is very important to be trained in science learning so that students have logical reasons, clear views, and rational explanations of things learned [10].

In addition, critical thinking skills have a positive effect on student argumentation. Argumentation plays an important role in developing critical thinking patterns and adding deep understanding of ideas [11,12]. A new idea put forward by someone shows that the person is able to understand and can argue correctly or not. So the basis for argumentative opinions is thinking, logical and realistic explanations of things learned [13,14].

However, good learning must be supported by good learning models. Science learning with guided inquiry model is able to facilitate students in learning to argue [15,16]. Stages of guided inquiry learning models include: orientation, formulating problems and hypotheses, collecting data individually or in groups, testing hypotheses and formulating conclusions [17]. These stages are in line with the scientific approach, namely the approach that trains the scientific attitude of students. The integration of approaches and learning models emphasizes the cooperative learning activities of students [18-22].

Based on the description above, is necessary to develop science teaching materials on the topic of material classification and changes for grade VII students of junior high school. It is caused by teaching materials used in schools that are subject to research are still limited to science textbooks from publishers so students lack reference in looking for additional material, in terms of material not packed with scientific approach or constructivism learning models such as guided inquiry so students are not accustomed to be active and independent in learning, as well the textbook is still oriented towards material content and is seen to lack training in HOTS, especially students' argumentation skill so students can't to present their arguments scientifically. This research focuses on development of teaching materials based on guided inquiry models to promoting students' argumentation skill on indicators claims, evidence, reasoning, and rebuttal which is logical, coherent, solid, and easily understood in accordance with the 2013 curriculum, competencies in syllabus, and students' thinking development.

Methods

This research is a development research (Research and development / R & D) aimed at developing a product in the form of a science teaching book for junior high school students material classification and changes. This research was conducted at Mataram public Middle School. The development model used is the development model of Borg & Gall which consists of 3 steps, namely research and information collecting, planning and developing preliminary form of product [23]. The validation subject consists of a team of experts and practitioners. The expert team is lecturer in Master of Science education at the University of Mataram and a practitioner by a science subject teacher. While the

subjects of the trial are limited to junior high school students in the Mataram City area of West Nusa Tenggara Province, Indonesian. Limited trials were carried out on 15 students of class VII SMP in Mataram. The data obtained from the validation are in the form of quantitative and qualitative data. The formula used to calculate Content Validity (V) is the Aiken's formula. Aiken's V statistics are formulated as follows [24]:

$$V = \sum s/[n(c-1)] \qquad (1)$$

With s, that is the number given by the appraiser minus the lowest validation score, c, which is the highest validity score, and n, the number of validators. Furthermore the value of content validity obtained is confirmed by the evaluation criteria as follows: (1) 0.00-0.20 it can be classified in a very less valid category; (2) 0.21-0.40 then it can be classified in the less valid category; (3) 0.41-0.60 then it can be classified in a fairly valid category; (4) 0.61-0.80 then it can be classified in the valid category; and (5) 0.81-1.00 then it can be classified in a very valid category.

3. Result and Discussion

Data collection is the basis for the development phase. Research and information collecting is done through (1) analysis of needs and competencies, (2) analysis of students, (3) analysis of learning devices and (4) literature study. In the needs analysis and competencies carried out by analyzing the curriculum used, facilities and infrastructure, so based on that it can be determined what is needed. Curriculum analysis finds the learning process lacking in billing indicators at a higher level of thinking. Then the student analysis shows that students are poorly trained in the learning process that emphasizes 21st century skills and has an impact on students' curiosity towards science learning. Previous research has shown that curiosity has a positive impact on learning outcomes [25].

The analysis of learning devices carried out by analyzing the devices used in learning including learning resources and supporting device such as lesson plans (RPP) and student worksheet (LKPD). Based on the results of the analysis note that the application of lesson plans is less effective in learning such as learning steps that tend to be non-operational and are routine activities so there is no specification of the learning steps according to their character subject matter or student development.

Furthermore, Literature studies are carried out by referring to theories that are in accordance with the problem and the results of the initial analysis, and also the study of the results of previous studies that are related so that they can be used as conclusions in deciding which products will be developed.

The planning stage is the design stage to support the supporting parts and the format of guided inquiry-based teaching material. The stages of the guided inquiry learning model used in this study are (1) student orientation to the problem; (2) organizing students to formulate problems; (3) formulating a hypothesis; (4) collecting data; (5) testing hypotheses; and (6) make conclusions [26].

Meanwhile, the indicator of students' argumentation skill applied in teaching materials consists of (1) Claim, is the answer to a question / problem or to identify an argument, criticism of an argument, and conceptual understanding; (2) Evidence, is a supporting data or information that supports a claim that comes from sources that can be observed in the same way by anyone and features are constantly observed. Data must be appropriate and sufficient to support the claim; (3) Reasoning, is an explanation of how the evidence supports the claim and invites or convinces others that the evidence used can support the claim; and (4) Rebuttal, describing alternative explanations or providing counter evidence. Rebuttal can also be interpreted as evidence that negates or disagrees with the rebuttal [27].

The stage of developing the preliminary form of product is a summative evaluation in which the products produced are then validated by experts in the field of education. The validity aspect relates to two things, namely: (1) the learning devices developed are based on strong theoretical rationality, and (2) there is internal consistency [28]. In this research the validation was conducted by three experts in the field of education. Parts of validated products include formats, contents, language, presentations, and innovation. The results of the validation can be seen in Table 1.

Table 1. Instructional Materials Validation Test Results

No.	Aspect	Value		
		V1	V2	V3
1.	Format	10	11	11
2.	Contents	40	35	40
3.	Language	13	13	15
4.	Presentation	12	10	15
5.	Innovation	15	15	16
Average		0.75		
Category		Valid		

Table 1 shows that the value of the average content validity is 0.75, meaning that the teaching materials developed have met the eligible criteria for use. Previous research also shows that teaching materials that meet the eligibility criteria of the validator can be used in the learning process [29-30]. Trials are part of assessing the practicality of learning devices developed. Data on practical results obtained include teacher responses and student responses. Data from teacher response can be seen in Table 2.

Table 2. Practical Test Results Based on Teacher's Response

No.	Aspect	Value		
		P1	P2	P3
1.	Format	12	13	14
2.	Contents	45	42	43
3.	Language	13	13	15
4.	Presentation	14	12	15
5.	Innovation	17	17	18
Average		0.84		
Category		Very practical		

Table 2 shows that the average practicality value of 0.84, meaning that the teaching materials developed are very practical to be applied in science learning in junior high school. This is supported by the results of descriptive analysis of observational data that shows that teachers are excited to carry out the teaching and learning process using the developed teaching materials. The teacher is excited about using this teaching material caused by the researcher first communicates the teaching material to the teacher so that in the implementation the teacher already knows the flow of learning in general, not awkward, and confused. Other practical data was obtained from the response of 15 students. The results of the assessment showed a different level of practicality, in sampled school 1 obtained Aiken's V score of 0.89 with a very practical category, in sampled school 2 Aiken's V score of 0.79 with practical categories and in sampled school 3 obtained Aiken's V score of 0.72 with a practical category. The results of the assessment can be seen in table 3.

Table 3. Practical Test Results Based on the Response of Students

No.	School name	Value	Average	Category
1.	Sample school 1	0.89		
2.	Sample school 2	0.79	0.80	Practical
3.	Sample school 3	0.72		

The difference in the practicality criteria of teaching materials in each school is in accordance with the results of the researchers' initial observations that students in sample school 1 have often carried out learning activities such as group discussions and practicums using a guided inquiry model compared to students on sample school 2 and 3.

Science teaching materials that contain indicators of students' argumentation skill are then implemented through a guided inquiry learning model. A guided inquiry learning model in teaching materials can attract the attention of students due to the approach used is the scientific approach, approach that trains the scientific attitude of students. The integration of approaches and learning models emphasizes the cooperative learning activities of students. The students' argumentation skill can be developed by cooperative learning through discussion activities in the learning process [31]. The discussion process can facilitate students to build scientific arguments by giving other students the opportunity to argue and to reject opinions that are considered incompatible with the concept of science [32-33]. Through argumentation, students are cognitively directly involved in solving problems, developing explanations based on scientific evidence, and communicating their ideas. Those way students will be motivated in learning [34].

The test results are the same as previous studies showing that the use of inquiry-based teaching materials by teachers and students obtain practical responses in learning [35]. This is supported by the results of descriptive analysis of the learning process using science teaching materials that contain indicators of students' argumentation skills. Students become active and independent throughout the learning process, especially in delivering scientific arguments that include claims and evidence. This is caused by the context of the material and practical activities in teaching materials that have been adjusted to the daily lives. The success of the learning process occurs when students truly understand what they are learning (deep learning) so that they are able to apply it in everyday life [36]. Teacher creativity is very necessary to be able to create interesting learning activities [37]. Learning is strongly influenced by several components such as learning materials or devices and classroom settings [38].

In the third stage, revisions and improvements to product development were also carried out based on suggestions and comments from experts, teachers and students. Improved suggestions and comments are shown in Table 4.

Table 4. Suggestions and comments

No.	Assessment	Suggestions and comments
1	Validator	The material description on teaching materials does not need to be presented too dense.
		The inquiry stage on the investigation sheet must be clear at each meeting by giving an activity number.
		The background, color, and design on the outer cover of the teaching material are replaced to make it look attractive.
		The format and design of writing on teaching materials need to be considered.
		Data needs to be searched which are presented in the form of current, interesting, and orientation to daily life..
		The presentation of data in tables is made easier for students to understand.
		The language used in teaching materials must be adjusted to the ability of users, namely students and teachers.
2	Teacher	Time allocation needs to be considered in each learning activity.
		The indicator argues for the sub-elements, compounds, and mixtures need to be added.
3	Students	Difficulty in answering questions in teaching materials, because it requires a lot of explanation in answering.
		Pictures on teaching materials are not HD quality.

The fourth stage, systematic reflection and documentation is a stage that can be done at each subsequent stage. At this stage documentation is carried out the end of each procedure at each stage of development. Furthermore, design specifications are carried out and articulate the relationship with the established frame of mind so as to produce final conclusions on the quality of the teaching materials developed.

4. Conclusion

Science teaching materials on the topic of material classification and changes for grade VII students of junior high school have been produced by adapting the development of Borg and Gall. Teaching material developed follows the stages of the inquiry learning model, which is to formulate problems, formulate hypotheses, collect data, test hypotheses, and make conclusions. In addition, the developed teaching material includes indicators to promoting students' argumentation skills such as claims, evidence, reasoning, and rebuttal. The parameters used to determine the quality of teaching materials developed are validity and practicality. The validity and practicality of the teaching materials developed were analyzed using Aiken's V. The results of the feasibility test based on the results of expert validation were obtained by Aiken's V of 0.75 with valid criteria, while the practicality test results based on teacher and student responses obtained Aiken's V scores in a row 0.84 (very practical) and 0.80 (practical). In conclusion, the teaching materials developed includes the criteria for developing quality products that are valid and practical for promoting students' argumentation skill.

5. References

[1]　BSNP 2010 *Paradigma Pendidikan Nasional Abad XXI* Jakarta: BSNP

[2]　Binkley M Erstad O, Herman J, Raizen S, Ripley M, Miller-Ricci M and Rumble M 2012 Defining twenty-first century skills *Assessment and teaching of 21st century skills* 17-66

[3]　Kelly G J and Takao A 2002 Epistemic levels in argument: An analysis of university oceanography students' use of evidence in writing *Science education* **86** 3 314-342

[4]　Azmy M K, Purwoko A A and Hadisaputra S 2018 The development of chemistry teaching materials in the form of handouts based PBL in class XI IPA Madrasah Aliyah (Ma) Kediri district *IOSR Journal of Research & Method in Education* **8** 3 71-73

[5]　Hakim A and Jufri A W 2017 Applications of isolation and structure elucidation of secondary metabolites in natural product chemistry laboratory *Book Chapter in Advances in Chemistry Research, NOVA Publisher New York*

[6]　Cetin P S 2014 Explicit argumentation instruction to facilitate conceptual understanding and argumentation skills *Research in Science & Technological Education* **32** 1 1-20

[7]　Sunarto W, Sumarni W and Suci E 2008 Hasil belajar kimia siswa dengan model pembelajaran metode think pair share dan metode ekspositori *Jurnal Inovasi Pendidikan Kimia Universitas Negeri Semarang* **2** 1 244-249

[8]　Ningsih Y C, Purwoko A A and Hadisaputra S 2018 Development of learning-based pogil (process oriented guided inquiry learning) to improve mastery of base student concept of acid base material in senior high school *IOSR Journal of Research & Method in Education* **8** 3 04-06

[9]　Kurniawan A D 2013 Metode inkuiri terbimbing dalam pembuatan media pembelajaran biologi untuk meningkatkan pemahaman konsep dan kreativitas siswa SMP *Jurnal Pendidikan IPA Indonesia* **2** 1 8-11

[10]　Heng L L, Surif J and Seng C H 2014 Individual versus group argumentation: Student's performance in a malaysian context *International Education Studies* **7** 7 109-124

[11]　Deane P and Song Y 2014 A case study in principled assessment design: Designing assessments to measureand support the development of argumentative reading and writing skills *Psicología Educativa* **20** 2 99-108

[12]   Noviyani M, Kusairi S and Amin M 2017 Penguasan konsep dan kemampuan berargumentasi siswa smp pada pembelajaran ipa dengan inkuiri berbasis argumen *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan* **2** 7 974-978

[13]   Keraf and Gorys 2010 *Argumentasi dan Narasi* Jakarta: PT. Gramedia Pustaka Utama

[14]   Ogreten B 2014 Examining the effectiviness of science teaching based on argumentation *Journal of Turkish Science Education* **1** 11 75-100

[15]   Senjaharmini A D, Jufri W A and Jamaluddin 2019 Efektivitas bahan ajar IPA berbasis inkuiri terbimbing (BAIPAIT) untuk meningkatkan kemampuan berargumentasi peserta didik *Jurnal Pijar MIPA* **14** 2 1-5

[16]   Seprianingsih D, Jufri W A and Jamaluddin 2017 Pengembangan perangkat pembelajaran biologi berbasis inkuiri terbimbing (PPBIT) dalam meningkatkan kemampuan berargumentasi siswa *Jurnal Penelitian Pendidikan IPA (JPPIPA)* **3** 2

[17]   Sanjaya W 2013 *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan* Jakarta: Kencana Prenada Media Grup Kencana

[18]   Hartono R 2014 *Ragam Model Mengajar yang Mudah Diterima murid* Yogyakarta: DIVA Press

[19]   Wildan W, Hakim A, Siahaan J and Anwar Y A S 2019 A stepwise inquiry approach to improving communication skills and scientific attitudes on a biochemistry course *International Journal of Instruction* **12** 4 407-422

[20]   Yustiqvar M, Gunawan G and Hadisaputra S 2019 Analisis Penguasaan Konsep Siswa yang Belajar Kimia Menggunakan Multimedia Interaktif Berbasis Green Chemistry *Jurnal Pijar Mipa* **14** 3 135-140

[21]   Andayani Y, Hadisaputra S and Hasnawati H 2018 Analysis of the Level of Conceptual Understanding *Journal of Physics: Conference Series* **1095**

[22]   Hakim A, Liliasari, Kadarohman A and Syah Y M 2016 Improvement of student critical thinking skills with the natural product mini project laboratory learning *Indonesian Journal of Chemistry* **16** 3 315-321

[23]   Sukmadinata and Syaodih N 2013 *Metode Penelitian Pendidikan* Bandung: PT Remaja Rosdakarya

[24]   Azwar S 2013 *Reliabilitas dan Validitas* Yogyakarta: Pustaka Pelajar

[25]   Ameliah H, Munawaroh I, Muchyidin M A 2016 Pengaruh keingintahuan dan rasa percaya diri siswa terhadap hasil belajar matematika kelas VII MTs negeri kota Cirebon *Eduma* **5** 1 9-21

[26]   Sanjaya W 2013 *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan* Jakarta: Kencana Prenada Media Grup Kencana

[27]   McNeill K L 2011 Elementary student's views of explanation, arrgumentation, and evidence, and their abilities to construct arguments over the school year *Journal of Research in Science Teaching* **48** 7 793-823

[28]   Plomp T and Nieveen N 2013 *Educational Design Research, Part A: An Introduction* Enschede, Netherlands: Netherlands Institute for Curriculum Development (SLO)

[29]   Farda J, Binadja U A and Purwanti E 2016 validitas pengembangan bahan ajar IPA bervisi SET *Journal of Primary Education* **5** 1 36-41

[30]   Amin and Kholiqul A 2016 Analisis bahan ajar modul statistika pada program studi pendidikan matematika IKIP PGRI Bojonegoro *Jurnal Edutama* **7** 6 1-9

[31]   Acar O 2008 *Argumentation skills and conceptual knowledge of undergraduate students in a physics by inquiry class* Doctoral dissertation: The Ohio State University

[32]   Ihsan M S, Ramdani A and Hadisaputra S 2019 Efektivitas model blended learning dalam pembelajaran kimia untuk meningkatkan kemampuan berpikir kritis peserta didik *Jurnal Pijar Mipa* **14** 2 84-87

[33]   Llewellyn 2013 *Teaching High Scholl Science Through Inquiry and Argumentation* USA: Corwin

[34]   Kaya E, Erduran S and Cetin P S 2012 Discourse, argumentation, and science lessons: Match or mismatch in high school students' perceptions and understanding? *Mevlana International Journal of Education (MIJE)* **2** 3 1–32

[35] Hasanah J, Jamaluddin and Prayitno H G 2019 Bahan Ajar IPA Berbasis Inkuiri Terstruktur untuk Meningkatkan Literasi Sains Peserta Didik SMP *Jurnal Pijar MIPA* **14** 2 1-7

[36] Toharudin U, Hendrawati S and Rustaman H A 2011 *Membangun Literasi Sains Peserta Didik* Bandung: Humaniora

[37] Pribadi B A 2009 *Model Desain Sistem Pembelajaran* Jakarta: PT. Dian Rakyat

[38] Auliah A 2018 Indonesian teachers' perceptions on green chemistry principles: a case study of a chemical analyst vocational school In *Journal of Physics: Conference Series* **1028**

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GENERAL COMMENTS

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