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Research paper



Scientific Approach in Islamic Junior High School Science Textbooks to Facilitate High Order Thinking Skills

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Abstract

This study aims to analyse textbooks used by students based on the scientific approach as the realization of learning objectives using the 2013 curriculum. This study did several things: first, an investigation of the teaching materials used by students based on the scientific approach, second studied the suitability of the content of textbooks used by students with the syllabus in the 2013 curriculum, thirdly investigating the contribution of textbooks used to higher-order thinking skills. Research method used is mixed methods namely descriptive method and survey study at Islamic Junior High School in Medan. There are 3 textbooks that will be analysed, the textbooks from three different publishers which used by the school. The total number of students who participated in this study were 201 students. Where students who participated in the study were selected based on purposive random sampling through certain considerations, the students come from Islamic Junior High School An Nizam, Islamic Junior High School Ulun Nuha, and Islamic Junior High School Al Fityan, the condition and character of schools are almost same, so is expected the homogeneous sample. The results obtained are: (1) From the three books, the results of conformity assessment with the syllabus in book A are 65%, book B is 80%, and book C 40%; (2) The evaluation results of the textbooks by using the scientific steps find that book A obtained a score of 53 in the low category, book B got a score of 58 in the low category, and book C got a score of 55 also in the low category; 3) The results of the assessment of HOTS ability of students from each school that use books A, B, and C are on the average low category.

Keywords: *Analysis, Scientific Approach, Science Learning Material, High-Level Thinking Skills*

1. Introduction

According Webster's New Collegiate Dictionary, science is "knowledge attained through study or practice," or "knowledge covering general truths of the operation of general laws, especially as obtained and tested through scientific method and concerned with the physical world." One of reason why we should study science written by Dusch[1] is science is an important part of human culture and is one of the peak of human thinking abilities. Other author, Wonorahardjo[2] said that science has the function of helping humans think in a systematic pattern because learning science is closely related to logic and mathematics to solve problems found in nature and life.

Science is also a branch of knowledge which is an indicator of measuring the success of education in a country. Based on the investigation report from Program for International Student Assessment (PISA) in 2015 that the scores of science literacy scale is grade 62 of the 70 participants' countries with an average score of 403. Science (IPA) is also one of the lessons tested in the National Examination. Based on the National Examination score report in 2018 the students' scores experienced a national decline, especially in mathematics lessons at 6.99 points and the Natural Sciences ranked second at 4.75 points, Faisal (2018). Based on the facts presented in the quality of education in Indonesia is still low, nationally, especially in science learning. Even though they don't turn a blind eye, there are 10 schools in Jakarta, with an average value reaching 80 and above[3].

Ideally science is a knowledge that must be learned through student involvement in science practices[4]. The practice of science learning aims to construct scientific explanations of physical phenomena[5]. Students can also improve their ability to give reasons and also their understanding of the science content[6].

Science education expected to be effective and relevant to society at large[7]. To achieve this goal, students need to be supported by the teacher and the contents of their science textbooks. By using appropriate teaching strategies, teachers can engage students in scientific explanations[4], and by using science textbooks can help students to get acquainted with scientific discourse[8]. According to McMurry and Fay[9] of the scientific method is a process of questioning and make experiments to find answers. From a psychology textbook, "the scientific method relates to a set of assumptions, attitudes, and procedures that guide researchers in creating questions to investigate, generate evidence, and make conclusions"[10]. Selection of textbooks that accommodate the realization of scientific steps is important to noted[11]. The 2013 curriculum mandates scientific use in learning as an effort to obtain the development of knowledge, attitudes, and skills[12].

Using a scientific approach in the learning process which is also included in textbooks are used to trigger students to actively construct concepts, laws or principles through guidance and independently. Using observing steps to identify problems, express problems, declare hypotheses, collect data, associate, conclude, communicate[13], [14]. Learning based on a scientific approach is more effective than traditional learning[7]. There are several achievements obtained when learning uses a scientific approach,

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namely: a) Presentation of learning that can increase curiosity, b) Improve observation skills (Encourage observation), c). Perform analysis (high-level thinking skills) and d). Communicate (Require communication).

2. Methods

This research uses mixed methods consists of descriptive method and survey study. In the first step an investigation is conducted on the suitability of the textbooks with the 2013 curriculum syllabus and a description of the quality of the textbooks based on scientific approach. Next assessment of students' high order thinking abilities using tests. This study was conducted as a preliminary stage in development research is to determine the quality of student teaching materials and students' high-order thinking abilities. There are 3 textbooks that will be analyzed, the textbooks from three different publishers which used by the school. The total number of students who participated in this study were 201 students. Where students who participated in the study were selected based on purposive random sampling through certain considerations, the students come from Islamic Junior High School An Nizam, Islamic Junior High School Ulun Nuha, and Islamic Junior High School Al Fityan, the condition and character of schools are almost same, so is expected the homogeneous sample.

The textbook assessment indicators are based on activities in each step quoted from Prihadi (2014)[15] as follow : 1. Observe with indicators there are objects observed, observation guidelines, and determination of how to record observations; 2. Ask with indicators diagnose initial knowledge "about what", awaken curiosity, “about why”, and develop the ability to think “about how”; 3. Try with indicators conduct experiment activities, there are experimental purpose, and experiment steps; 4. Associate with indicators there are questions to be analyzed, questions related to the experiment, activity to concluded; 5. Communicate with indicators there is a material that will be presented, explain the results of the experiment in the form of tables, graphs or diagram, the procedure for discussion. The textbook criteria for the remainder of the 2013 curriculum: 1) Referring to the curriculum concept means that it is in line with the 2013 curriculum syllabus in accordance with the basic competencies and standard learning activities formulated; 2) Student books are emphasized based on scientific activities not just reading material; 3) Contains learning models and projects that students will do[15].

3. Result and Discussion

Valuing the textbooks used by students is an interesting thing to do because it is related to learning outcomes through the 2013 curriculum. There are strong indications that for students to develop the ability to understand and build scientific explanations, students need to be acquainted with various aspects of the nature of science found from the textbook they use[16]. The analysis was conducted on three textbooks used by students based on the suitability of the learning activities listed in the syllabus and compared to the learning activities contained in the textbook. The material examined is the subject matter of physics (i.e. the object IPA and measurement) and chemistry (i.e. substance and its characteristics). Of the three books, the results of conformity assessment with the syllabus in book A were 65%, book B was 80%, and book C 40%. The facts obtained show that the quality of student handbooks varies greatly according to the syllabus. Textbooks that students used in learning which is one of the reference sources is certainly very influential to the mastery of learning outcomes expected by the curriculum. Therefore teachers should be critical when choosing textbooks for students when learning. So that the learning objectives expected in the syllabus are evenly accepted by these students. This is certainly related to the implementation of equalization of National Examination which assuming that the quality of schools in the Republic of Indonesia is also homogeny. But in reality it is certainly not the case, starting from the quality of teachers, facilities, pre-facilities, and the quality of the implementation of learning in the classroom certainly varies greatly in every school in each region. Textbooks are not the only component that plays an important role in the achievement of learning objectives mandated by the 2013 curriculum but it has an important role in learning.

Therefore, the ultimate goal of science education is to produce individuals who are able to understand and evaluate existing information and can make decisions by combining information appropriately. Then it will produce the number and diversity of skilled and motivated future scientists, science-based professional engineers.

Therefore the science curriculum in elementary classes must be designed for all students to develop basic knowledge that is very important in order to be able to use school scientific knowledge (ie laws, principles, rules, models, etc.). McCain (2015)[17] interests, and habits thoughts that will lead to productive efforts to learn and understand deeper lessons in class. If this is done well, then the five reasons for teaching science will be well realized.

In addition to analyzing textbooks based on compliance with the syllabus, then performed the analysis of textbooks based on the use of scientific approach in science textbooks. This is done to find out how the quality of textbooks used by students in order to meet the standards of textbook desired by the 2013 curriculum, namely: 1) Referring to the curriculum concept means conformity with the 2013 curriculum syllabus in accordance with basic competencies and standard learning activities formulated ; 2) Student books are emphasized based on scientific activities not just reading material; 3) Contains learning models and projects to be carried out by students[15], [18].

Table 1: Results of Investigation of Textbooks Based on Scientific Steps

Subject Matter	Steps of Scientific Approach	Score Book		
		A	B	C
Object of natural science and measurement	Observing	2	2	1
	Asking	2	3	1
	Trying	3	3	4
	Associating	2	3	3
	Communicating	1	1	1
Matter and its characteristic	Observing	1	1	1
	Asking	1	1	1
	Trying	4	3	4
	Associating	3	3	4
	Communicating	1	1	1

The results of the assessment of textbooks using scientific steps for two book A learning materials used by An Nizam school received a 53 score in the low category, book B obtained a score of 58 used by the Ulun Nuha school in the low category, and book C used by the Al Fityan school to score 55 also in the low category. Textbooks used in schools also become one of the determinants of student success in achieving learning goals. One of the learning objectives that must be mastered by students is high-level thinking skills (HOTS). Content or material contained in textbooks is one of the determinants of HOTS mastery. For this reason an investigation was conducted on the contribution of textbooks used on higher-order thinking skills (HOTS). The results of the investigation can be seen in table 2.

Table 2: Results of Investigation concerning the contribution of textbooks to Students’ HOTS

Book	School	Class	Average Score of Students’ HOTS	Explanation
A Score Scientific book 53	An-Nizam	VII SQ	48,57	Low category
		VII BB	8,75	Low category
		VII HA	23,27	Low category
B Score Scientific book 58	Ulun-Nuha	VII A	28,6	Low category
		VIIB	9,64	Low category

C Score Scientific book 55	Al-Fityan	VII A	16,75	Low category
		VII B	22,29	Low category
		VII C	5,38	Low category

Based on table 3 above it can be seen that there is a relationship between the scientific score of the book with the average value of students' Hots. The score of scientific book used by An-Nizam entered into the low category influences the mastery of high-level student thinking as evidenced by the still low average HOTS values of students. The same thing happened in Ulun-Nuha and Al-Fityan schools, the scientific score of the book used by students also had a low score which also influenced the students' HOTS ability.

Learning objectives with a scientific approach are based on the primacy of these approaches, including: (1) improving intellectual abilities, especially high-level thinking skills, (2) to shape students' abilities in solving problems systematically, (3) creating learning conditions where students feel that learning is a necessity, (4) obtaining high learning outcomes, (5) to train students in communicating ideas, especially in writing scientific articles, and (6) to develop students' character[19]. As we know that science materials are packaged using the flow of scientific thinking accompanied by critical thinking questions in learning materials presented explicitly to facilitate them with critical thinking skills and make learning relevant, contextual and meaningful. Learning focus on critical thinking and problem solving is not merely memorizing information.

4. Conclusion

The selection of textbooks that accommodate the realization of scientific steps is important to be done because it is based on the results of an assessment of several textbooks used by students to facilitate the development of higher-order thinking skills in the low category. Book A used by the school with the scientific book score of 53 (low category) influences the average ability of students' HOTS in the low category. Book B used by the school with the scientific book score is 58 (low category) also affects the ability of students' HOTS in the low category. While book C used by the school with the scientific book score is 55 (low category) also influences students' HOTS in the low category.

As we know that science materials are packaged using the scientific thinking path accompanied critical thinking questions in learning materials explicitly presented to facilitate them with critical thinking skills and make learning relevant, contextual and meaningful not merely memorizing information. If this is not fulfilled in textbooks, it can affect the process of developing students' HOTS abilities. Textbooks are not the only factor that influences students' high thinking skills. Besides textbooks, the learning process and the quality of teachers in teaching influence the enhancement of students' HOTS abilities. For further research, it is expected that a teaching material that can realize and implement scientific steps in learning. So between teaching materials and learning processes can run a harmonious process so that learning objectives that are expected to touch the cognitive, affective, and psychomotor domains can be realized?

References

[1] N. R. Council, *Taking Science to School*. Washington, D.C.: National Academies Press, 2007.

[2] S. Wonorahardjo, *Dasar-Dasar Sains : Menciptakan Masyarakat Sadar Sains*. 2010.

[3] Y. E. Harususilo, "Ini Daftar 10 SMP Jakarta dengan Nilai UN IPA Tertinggi - Kompas.com." [Online]. Available: https://edukasi.kompas.com/read/2018/05/27/15163041/ini-daftar-10-smp-jakarta-dengan-nilai-un-ipa-tertinggi. [Accessed: 27-Oct-2018].

[4] K. L. McNeill and J. Krajcik, "Scientific explanations: Characterizing and evaluating the effects of teachers' instructional practices on student learning," *J. Res. Sci. Teach.*, vol. 45, no. 1, pp. 53–78, Jan. 2008.

[5] L. K. Berland and B. J. Reiser, "Making sense of argumentation and explanation," *Sci. Educ.*, vol. 93, no. 1, pp. 26–55, Jan. 2009.

[6] K. L. McNeill and J. Krajcik, "Synergy Between Teacher Practices and Curricular Scaffolds to Support Students in Using Domain-Specific and Domain-General Knowledge in Writing Arguments to Explain Phenomena," *J. Learn. Sci.*, vol. 18, no. 3, pp. 416–460, Jul. 2009.

[7] C. Wieman, "Why Not Try a Scientific Approach to Science Education?," *Chang. Mag. High. Learn.*, vol. 39, no. 5, pp. 9–15, Jan. 2007.

[8] V. Koulaidis and A. Tsatsaroni, "A pedagogical analysis of science textbooks: How can we proceed?," *Res. Sci. Educ.*, vol. 26, no. 1, pp. 55–71, Mar. 1996.

[9] J. McMurry and R. C. Fay, *Chemistry*. Pearson Prentice Hall, 2008.

[10] D. H. Hockenbury and S. E. Hockenbury, *Psychology*. Worth Publishers, 2006.

[11] I. A. Kusumaningrum, A. Ashadi, and N. Y. Indriyanti, "Scientific Approach and Inquiry Learning Model in the Topic of Buffer Solution: A Content Analysis," *J. Phys. Conf. Ser.*, vol. 895, no. 1, p. 012042, Sep. 2017.

[12] K. P. dan Kebudayaan, "Konsep dan Implementasi Kurikulum 2013," 2014.

[13] D. Nezvalova, "The Constructivist Perspective and Teaching Integrated Science," *Int. J. Learn. Annu. Rev.*, vol. 12, no. 6, pp. 133–140, 2007.

[14] L. C. Chen, Y.-H. Chen, and W.-I. Ma, "Effects of integrated information literacy on science learning and problem-solving among seventh-grade students," *Malaysian J. Libr. Inf. Sci.*, vol. 19, no. 2, pp. 35–51, 2014.

[15] B. Prihadi, "PENERAPAN LANGKAH-LANGKAH PEMBELAJARAN DENGAN PENDEKATAN SAINTIFIK DALAM KURIKULUM 2013."

[16] A. Velentzas and K. Halkia, "Scientific explanations in Greek upper secondary physics textbooks," *Int. J. Sci. Educ.*, vol. 40, no. 1, pp. 90–108, Jan. 2018.

[17] K. McCain, "Explanation and the Nature of Scientific Knowledge," *Sci. Educ.*, vol. 24, no. 7–8, pp. 827–854, Oct. 2015.

[18] R. J. Rezba, C. (Constance R. . Sprague, J. T. McDonnough, and J. J. Matkins, *Learning and assessing science process skills*. .

[19] A. Machin, "IMPLEMENTASI PENDEKATAN SAINTIFIK, PENANAMAN KARAKTER DAN KONSERVASI PADA PEMBELAJARAN MATERI PERTUMBUHAN," *J. Pendidik. IPA Indones.*, vol. 3, no. 1, 2014.