DEVELOPMENT OF MULTIPLE REPRESENTATION BASED ON STUDENT WORKSHEETS TO IMPROVE SCIENTIFIC REPRESENTATION SKILLS

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Abstract

The dynamics in science education cannot be separated from the development of technology, along with developments, the age of technology is increasingly mastering various fields in the world, including in the world of education, one of the areas of education that is affected is science education. Science education is expected to be able to bring students to adventure exploring the natural surroundings and recognize themselves through the knowledge, theories, concepts, and principles contained in science learning in order to keep up with the developments in the world of education.

One of the schools that also requires learning development is MTsN 4 Magetan, which based on a survey on January 29 has problems, namely the lack of student representation ability and low ability to analyze HOTS questions. So there is a need for learning support that is able to improve the representation ability of students in the form of multiple representation-based worksheets.

This study aims to develop multiple representation-based worksheets that have been tested for validity, implementation and effectiveness. This research is a Research and Development (RnD) research with the Borg n Gall model. This LKPD product development was validated by 7 expert validators. The sample used was 20 students of class VII G as a limited-scale trial class and 32 students of class VII B as a large-scale trial class.

The developed LKPD product has been declared suitable for use by students after passing 3 stages of testing namely validity, implementation and effectiveness based on 3 main indicators of scientific representation ability, namely connecting students' experiences, problem solving skills and synthesizing information.

Keywords: Worsheets, Multiple Representation, Science Environment, Environment Pollution, HOTS

Introduction

The dynamics in science education are inseparable from the development of technology, along with the development of this technological era increasingly rapidly mastering various fields in the world including in the world of education, one of the education affected is science education where science education is expected to be able to bring students to adventure to explore the surrounding nature and recognize themselves through science, theories, concepts, and principles contained in science learning.[1] In the

[1] Yeni Astuti Puji, "Pengembangan Perangkat Pembelajaran Model Group Investigation Dengan Advance Organizer Untuk Meningkatkan Hasil Belajar Dan Keterampilan Pemecahan Masalah Pada Siswa SMP," *Sustainability (Switzerland)* 1, no. 2 (2020): 1–9, https://pesquisa.bvsalud.org/portal/resource/en/mdl-20203177951%0Ahttp://dx.doi.org/10.1038/s41562-020-0887-9%0Ahttp://dx.doi.org/10.1038/s41562-020-

development of the Revolution 4.0 era related to science and technology as it is today developing more rapidly along with the increasingly high demands of education, in the 21st century students are encouraged to have skills and must be able to be responsive to the phenomena that occur so that they are able to think scientifically and have standardized abilities.[2] We can see the ability of students in Indonesia in pisa (Programme for International Student Assessment) data published by the OECD (Organization for Economic Cooperation and Development) where the data shows that 42.3% of students are still below level 2 which means that they have not met international education standards such as explaining, interpreting and analyzing data through the results of experiments that have been carried out.[3]

According to TIMSS (Trends in Mathematics and Science Study) in Syamsul Hadi which is continuously carried out every 4 years, TIMSS data in 2015 states that Indonesia is ranked 35th out of 46 participating countries, the 2 subjects used as a reference in timss cover science and mathematics which has the aim of knowing the effectiveness of the form of curriculum that is being developed, this data states if we need to improve in many aspects in the field of education to be able to catch up in international standards.[4] The government in its efforts to continue to improve the quality of education in Indonesia through Law No. 20 of 2003 concerning the National Education System, which in its implementation has now implemented K13 which is being developed to prepare qualified natural resources for Indonesia.[5]

K13 in its journey is actually not fully able to make students have independent thinking, such as being able to draw conclusions at the end of learning without help from educators or understanding the essence of the learning that has been taught, so students need other help that is able to provoke their thinking to be able to think critically so that they can conclude and draw the essence of the learning process that has been taught by educators. We can do the assistance needed by students in the learning process to be able to think critically by providing LKPD, this LKPD contains guidelines for students in conducting an experiment. A good LKPD is an LKPD that is able to bring students to be able to think at a high level, and have good literacy skills, here the preparation of LKPD which is used to improve scientific representation skills is inseparable from the initial goal, namely to grow scientific thinking skills.

Education is an important indicator that cannot be separated from the process of improving quality in the progress of a country, as well as science education. Science education, which is in line with technological developments, makes an effective benchmark in the level of quality of education that is currently taking place. Science education invites students to be able to experience the surrounding nature which focuses on research experiments and problem solving.

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[5] Putri Sarini Luh Maeri Arjani , I Wayan Subagia, "Implementasi Kurikulum 2013 Dan Faktor-Faktor Yang Memengaruhi Pada Pembelajaran IPA Kelas VII Di SMP Negeri Kubutambahan Tahun Ajaran 2018/2019," *Jurnal Pendidikan Dan Pembelajaran Sains Indonesia* Vol. 3, no. April (2020): 21–30.

According to Bybee in Jack Holbrook stated that the development of students' skills is used to expand the range of skills in the field of science but the presence of significant emphasis will actually hinder the achievement of the multi-dimensional level of science literacy.[6] According to Vell and Lenderman in Jack Holbrook revealed that the growth of science encourages the development of the nature of science as a result of human effort.[7] According to Relia and Sodikin in the Ring of Nohan Rembulan stated that the development of individual potential is influenced by education, therefore the quality of education is a benchmark for the success and progress of a country so that it is important to improve quality.

According to Carind and Sun in Putu Victoria stated that there are 4 elements in science that must be possessed by students, namely 1) Attitudes that include honesty, conscientiousness, curiosity and have a relationship between cause and effect 2) The existence of processes, such as being able to randomize problems using the scientific method through performance performance performance carried out in experiments 3) Producing products that can be legal, theories, principles and facts, and the last 4) Applying them to the scientific method in his daily life.A good LKPD is an LKPD that is able to bring students to be able to think at a high level, and have good literacy skills, here the preparation of LKPD which is used to improve scientific representation skills is inseparable from the initial goal, namely to grow scientific thinking skills.[8]

Be scientifically insightful and responsive to scientific phenomena. Currently, character education in general is very necessary in welcoming the 4.0 era so that students are expected to have realistic characteristics that are able to compete without going out of the corridors set by the MINISTRY OF EDUCATION AND CULTURE, therefore science education is considered to be able to wrap the characteristics of students through learning which is not only about learning through natural phenomena but also following the trend of science and technology issues that are happening, and of course, it remains through the process of filtering information through the ability to think critically.

Method

The type of research used by researchers to develop multiple representation-based student worksheets is to use jeins RnD (Research and Development) research. According to Sukmadinata, RnD is a research where in its journey it is able to produce a product, both a new product and perfect one of the products from previous research. The RnD research used by researchers is Borg n Gall's RnD theory. Borg and Gall themselves explained that in research using the RnD method, it has 10 stages, namely research and informating collecting, planning, develop preliminary form of product, preliminary field testing, main product revision, main field testing, oprational product revision, oprational field testing, final product revision and the last one is dessimination and implemantation.

The research subjects used in this study were class VII students, with a class of 1 class consisting of 32 students. The sampling technique used in this study was Purposive

[6] Jack Holbrook and Miia Rannikmae, "The Nature of Science Education for Enhancing Scientific Literacy," *International Journal of Science Education* 29, no. 11 (2007): 1347–62, https://doi.org/10.1080/09500690601007549.

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[8] Putu Victoria M Risamasu, "PEMBELAJARAN IPA MENUMBUHKAN KARAKTER SISWA Putu Victoria M. Risamasu," no. 20 (2016): 249–59, https://doi.org/10.5281/zenodo.1039985.

Sampling where the choice of this technique was based on the consideration of class VII science teachers in the school where the research took place. The research was conducted at MtsN 4 Magetan.

Result and Discussion

The results of the research analysis from the development of multiple representation-based student worksheets using the Borg and Gall method. According to Borg and Gall itself in Punaji means that development research or RnD is used to validate a product of the research being carried out. The Borg and Gall research method has 10 stages in it, namely research and information collecting, planning, develop prileminary form of product, preliminary field, main product revision, main field testing, operational product revision, operational field testing, final product revision, and the last is dissemination and implementation.

In the validity test that the researcher has carried out using 7 expert validators consisting of 4 science teachers and 3 science lecturers, the researchers get the results of the LKPD assessment and the representation ability test questions carried out. Validity is the result of validation that has been carried out in the collection of empirical data to determine the quality of the instruments to be used in research. The validity result is then calculated using the Aiken formula and will be compared with the standard aiken value of 0.79. easily declared valid with a value of 0.857143. Next is the indicator containing life issues related to IPA with a value of 0.928571, then on the indicator of representation ability with a value of 0.78714. In the LKPD arrangement indicator in accordance with the LKPD research procedure with a value of 0.928571, then the LKPD indicator is interesting for students. 0.785714. next is on the language indicator used to get a value of 0.857143, then on the indicator language used using communicative language with a value of 0.964286. In the PUEBI language rule indicator, it gets a value of 0.821429. Then the assessment indicators can connect the experience of students with a value of 0.821492. Then the assessment indicator contains skills in solving problems getting a value of 0.928571. the last is on the assessment indicator synthesizing information declared valid with a value of 0.857143.The indicator used is declared valid with a value exceeding the standard aiken value of 0.892857. Then on the indicators instructions can be implemented.

Meanwhile, in the reliability test, the questions analyzed are about representation ability with a total of 10 questions. This reliability test was tested using croncbach's alpha formula where the calculated R must be greater than the table R which is 0.444. the tenth reliability test of this question was declared reliable with the final result of 0.721. which means that this question can be used to test the representation ability of students.

Adzwar suggests that the main character of a good instrument measurement is to look at its reliability. We can determine whether or not this reliability is good by testing the same questions in different groups and at different times. This reliability is used in testing the feasibility of the representation ability test questions used by researchers. The analysis of the points of this question is said to be very important for the sustainability of the quality of the instrument so that it has advantages including being able to help evaluate the quality of the question items, relevant for the preparation of the test that will be used by the teacher or tested on students and there is no support in the effectiveness of the research of the question manuscript.

The level of implementation of LKPD based on multiple representation is measured using an implementation questionnaire given to students, teachers and observers. The data obtained were then analyzed using MS. Excel with the percentage of teacher questionnaire data in the trial class limited to 97% in the objective aspect, 90% in the material aspect, 89% in the aspect of using LKPD and 91% in the aspect of LKPD success. Then proceed with the calculation of the standard deviation with a mean result of 45.6. Furthermore, in the assessment implementation score from teachers and observers, the percentage of 33% is good and 67% is sufficient. The implementation of this teacher then experienced an increase in the broad-scale trial class where the results of the goal were 100%, then in the material aspect by 91%, in the aspect of using LKPD by 91% and finally in the aspect of LKPD success by 91%. The standard deviation value also has an increase in the mean of 46.6 so that the final result percentage is 3% good and 67% is sufficient.

The next implementation questionnaire is the one filled in by students, the results of this questionnaire calculation are divided into 2, namely a limited trial class and a large-scale trial class. The questionnaire of implementation in the limited-scale trial class was on the aspect of the goal 3% disagreed, 23% quite agreed, 63% agreed and 13% strongly agreed. Then on the material aspect 8% disagreed, 18% quite agreed, 75 agreed and 50% strongly agreed. Furthermore, in the aspect of using LKPD, the percentage of 15% disagreed, 28% quite agreed, 75% agreed and 33% strongly agreed. Finally, in the aspect of the implementation of LKPD with a percentage of 10% strongly disagree, 8% disagree, 28% quite agree, 75% agree and 33% strongly agree.

Meanwhile, the questionnaire on the implementation of students in large-scale trial classes resulted in a percentage of objective aspects of 4% disagreeing, 9% quite agreeing, 41% agreeing and 13% strongly agreeing. furthermore on the material aspect get a percentage value of 2% strongly disagree , 1% disagree, 15% quite agree, 50% agree and 33% strongly agree. The use of LKPD received a percentage score of 3% strongly disagreed, 3% disagreed, 22% disagreed, 41% agreed and 32% strongly agreed. the last is in the aspect of LKPD implementation, namely 5% disagree, 15% quite agree, 40% agree and 41% strongly agree. based on the results of the calculation of the percentage above the multiple representation-based LKPD, it is stated that it is well implemented.

The implementation of LKPD based on multiple representation is stated to be carried out because the design in the LKPD is made to consider many things. Among them is the selection of the dominant color that will be used by choosing green, this green color is a color that is very close to nature so it is very suitable in bringing environmental pollution material. In addition, the choice of green color so that readers are more comfortable because green has cool and beautiful color properties. El Ghifary explained that the results of his research on the use of color determine the level of comfort of a person in reading, it was also stated that the use of green is more comfortable to use than using blue.

The effectiveness of LKPD based on multiple representation can be seen from the increase in tests carried out during limited-scale trials and large-scale trials. The difference can be seen from the results of the N-Gain value test that has been carried out, this N-Gain test is used to assess the representation ability of students.

The N-gain test result at the limited-scale trial stage was 0.42. Then it experienced an increase at the time of the wide-scale trial with the improvement of LKPD and the previous ability test questions, so that the result of the N-gain value of the broad-scale trial class was

0.46.Furthermore, the image feature displayed in the multiple representation-based LKPD is used to facilitate the imagination of students when learning to understand the material on environmental pollution. Hamalik stated that the use of illustrated media will increase the learning activities of students and increase the curiosity of students.

The effectiveness of this LKPD is also calculated by the percentage using the MS application. Excel with the result of 56% agreed and 44% strongly agreed that this LKPD had met the requirements of the content and purpose of the LKPD. Then the multiple representation-based LKPD design got a percentage of 87% agreed and 13% strongly agreed that the design used could make it easier for students to understand the material and make the learning atmosphere more comfortable. Finally, the language used so that students can understand what is conveyed in the LKPD based on multiple representation, so that 93% agree and 7% strongly agree, so that the material presented can be well understood by students.

This N-Gain test was carried out to determine the improvement of student representation ability, Azizah revealed that representation ability is the ability to solve or describe a problem to be simpler in terms of solving it. Where solving this problem will encourage individuals to think, from here we can see the cognitive style of learners in solving or solving a problem. Each learner has a different cognitive style and is also a characteristic of that individual that he only has and cannot find similarities in other individuals.

This representational ability has 3 main indicators as a measuring tool for understanding students' representation abilities, namely connecting student experiences, problem-solving skills, and synthesizing information. This representational ability is considered very important for students to have, the same thing was also conveyed by Wahyudin that this representation ability will lead students to be able to develop their ideas and thoughts which can then be used flexibly in the process of solving problems in everyday life.

Conclusion

Based on the results of the analysis data that have been previously presented, it can be concluded that. First the product of developing multiple representation-based student worksheets is declared valid through the improvements that have been made, so that it is declared suitable to be used as a supporting medium for learning in schools. Second the product of developing multiple representation-based student worksheets is stated to be carried out well with satisfactory results based on questionnaires that have been distributed to students, teachers and observers. Last is the product of developing student worksheets based on multiple representation is expressed as effective to help improve the scientific representation ability of students based on the results of tests that have been carried out.

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