Alternative kits and worksheets on light and optics as science experimental devices at home for middle school student

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Abstract. The aims of this research concerned to develop an alternative kits and worksheet on light and optics as science experimental devices at home for middle school student. The method used is a research and development. Alternative kits and worksheet have been tested for feasibility through empirical testing and validation. The research data were analyzed by calculated the index of each indicator instrument experiment. The result showed that science experimental devices is appropriate for home learning activity according to evaluation by a material expert and peer reviewers as well as according to result of middle school students try outs with respective high category.

1 Introduction

Teaching science in schools is divided into two major parts, namely science as a product and science as a process. The context of science as a product is in the teaching of facts, theories, principles and natural laws; while science as a process is the development of students' abilities in scientific methods and problem solving in science. For science as a process, teaching through laboratory practicum is an activity of applying the scientific method by students. There are many claims that laboratory practicum activities can improve students' critical attitude, science process skills, or scientific attitude [1]. Besides that, science learning is also expected to provide psychomotor skills, scientific attitude skills (affective), understanding, habits and appreciation in finding answers to a problem [2].

The most suitable learning method for developing process skills is the experimental method. The experimental method is a method in which students experience and prove for themselves something they have learned [3]. The description above shows the importance of conducting experiments for students, but in general, the implementation of experiments that take place in school laboratories is rarely carried out by teachers. Based on the results of Jeperis' research, the reasons why teachers rarely do practicum are as follows: 1) unavailability of laboratories in schools, 2) unavailability of science practicum tools, 3) teachers do not have a science educational background, 4) teachers rarely attend training on the use of science laboratories, 5) the implementation of training on the use of laboratories is rarely carried out, 6) teachers lack understanding of the use of labor, and 7) there are no laboratory assistants. In addition, based on Sumintono's research to carry out practicum in the laboratory in supporting the learning process, there are several difficulties, including; Insufficient tools and materials, lack of time, limited space, and the absence of a laboratory [1].

Practicum become less effective, due to inadequate lab space, incomplete laboratory equipment, less effective practice time given the absence or lack of equipment preparation (no laboratory assistant), irregular practice due to the absence of a practice schedule. However, sometimes problems occur due to insufficient time with limited materials and equipment, which makes it difficult to apply the experimental method in schools, especially at the middle school level. In order to conduct the practicum, experimental devices are needed which consist of tools and materials used for experiments as well as guidelines. For this reason, experimental devices are needed which covered in the material that student learned during their study without being constrained by non-existent laboratories and unavailability of tools. One solution is to utilize a set of tools sourced from the environment that can be used as learning media. This set of tools is then referred to as an alternative kit.

The alternative kit in question is a set of experimental tools that are practical and can be taken home so that they can overcome the problem of limited time and space. The development of this alternative light and optical kit is also accompanied by the development of effective and efficient Student Worksheets (LKS), so that teachers can provide understanding to students. Light and optics are chosen because light and optics are one of the physical concepts that have many applications in nature and therefore a device is needed to make observations and provide an explanation of the concepts of light and optics. The objectives of this research are 1) assembling tools and materials and packaging them in an Alternative Kit for the topic of light and optics, 2) testing the validity of the Alternative Light and Optics

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Kit, 3) testing the validity of the LKS Alternative Kit for Light and Optics.

2 Research Methods

The form of research is used research and development method, because it aimed to find and develop a new or existing prototype in order to improve and develop so that more productive, effective and efficient results are obtained.

Research and development is a method used to develop and test a product. Research and development is a research approach to produce new products or improve existing products. There are three steps of research and development; a preliminary study to examines theory and observes existing products or activities; developing new products or activities; testing and validating new products or activities [4]. The research flow can be seen in Figure 1.

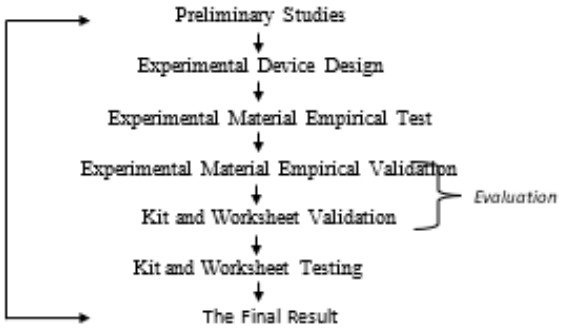

Fig. 1. Research Flow of Light and Optical Alternative Kit Development

The beginning of this research is start from analyze the constraints on the needs of students in the use of standard practicum kits used in schools as well as information related to the problems to be studied. Based on information from experts and literature studies, Experimental Device Design, is done by determining the experimental topics to be developed. The design at this stage, based on the analysis of concepts, is relevant to the characteristics of the light experimental device.

Development of Experimental Equipment in the form of preliminary preparation of experimental devices and light worksheets by selecting tools and materials to be used as alternative media for these devices, as well as designing the appearance of kits and worksheets in accordance with the development objectives. Experimental material empirical test, in this stage the alternative device material is tested and the best is selected in showing the expected physical symptoms so that it can be used to carry out light experiments. To validate the experimental devices, we asked four senior lecturer with a list of questionnaires in the assessment list. On the assessment sheet there are indicators that will be assessed by the validator along with a suggestion column. Repairs and improvements to the device are carried out based on the suggestions given.

Testing of Experimental Equipment, at this stage the implementation of testing of experimental devices is carried out through the implementation of limited practicum trials by 10 students of middle school level. The selection of research subjects was based on consideration of the diversity of academic abilities. The practicality test process was continued with the activity of filling out the practicality test assessment sheet for the light experiment.

Evaluation, in this study, a formative evaluation took place at each of the four stages above because it aimed at the need for revision or improvement of the experimental device. The final result is an experimental device consisting of an alternative kit and light and optical worksheets in sizes that can be brought home by individual students who have been tested for feasibility.

The data analysis technique used in this research is descriptive analysis, namely by calculating the index of each LKS validation indicator and testing the practicality of the experimental equipment. The validity of the LKS is determined by the score of the validation results by expert lecturers. While the practicality test of the experiment is determined by the assessment score given by the students after doing the practicum.

Analysis of the validation data using the following steps:

1) Summing up each indicator of the validation questionnaire.
2) Questionnaire assessment categories by validators and practicality tests by students using the guidelines as shown in Table 1.
3) Find the average of each indicator of the validation questionnaire.
4) Find the average of the whole validation questionnaire.
5) Determine the average category of indicators based on the table using a Likert scale.

Table 1. Questionnaire Assessment Categories

No	Category	Skor
1	Strongly agree	4
2	Agree	3
3	Disagree	2
4	Do not agree	1

Table 2. Categories of Validation and Practicality by Practitioners

No	Average Score	Category
1	$> 3{,}25 - 4$	Very high
2	$> 2{,}5 - \leq 3{,}25$	High
3	$< 1{,}75 - \leq 2{,}5$	Low
4	$1 - \leq 1{,}75$	Very low

To determine the average per indicator used the formula:

Average per indicator = (Number of Scores Per Indicator)/(Number of Validators) (1)

3 Results and Discussion

3.1 Result

Preliminary studies. Based on the information and literature study, the researcher obtained information that laboratory practicum activities can improve students' critical attitude, science process skills, or scientific attitude. Besides that, science learning is also expected to provide psychomotor skills, scientific attitude skills (affective), understanding, habits and appreciation in finding answers to a problem. The most suitable learning method for developing process skills is the experimental method. The experimental method is a way of presenting lessons in which the subject learns to experiment by experiencing and proving himself something learned.

Experimental Device Design, based on the results of the preliminary study, the learning device developed in this research is the Light and Optical Alternative Kit and Student Worksheet which is effective and efficient, which is able to solve the problems described in the preliminary study. Development of experimental devices, at this stage the development of worksheets is carried out which is adapted to experiments or activities designed by researchers so that students can easily observe light symptoms in a simple way but still can master and understand the concept of light. During this stage, several revisions were made as needed.

The results of the assessment of alternative kits and worksheets can be seen in the following description. From the assessment of the Alternative Light Kit by the Validator, the results of the data analysis are obtained in Table 3.

Table 3. Validation Results of Alternative Light and Optical Kits

No.	Indikator							
	1	2	3	4	5	6	7	8
Average	3,47	3,5	3,72	3,78	3,09	3,97	4	3,35
Conc	VH	VH	VH	VH	VH	VH	VH	VH

Based on the analysis table above, it can be seen that the alternative kit developed in this study can be declared valid for experiments of light material. The validation, the results are summarized in Table 3. Based on the recapitulation table for assessing the validity of the worksheets above, it can be seen that the worksheets is valid to be used by middle or junior high students and equivalent to show the symptoms contained in the light material. Testing of experimental devices is carried out by students by filling out an experimental practicality test assessment sheet. Based on the recapitulation table of the worksheets practicality assessment above, it can be said that the alternative kit and light worksheets have a very high level of practicality, and high for indicator 2.

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Fig. 2. Alternative light and optical kit

3.2 Discussion

After evaluating the alternative kits and light worksheets, both validators and practitioners generally gave a positive assessment, so that no significant problems were found. This is shown by the assessment scores ranging from high to very high, as well as enthusiasm in providing feedback and suggestions on various aspects of developing alternative kits and light worksheets.

The alternative kits and light worksheets developed are expected to overcome the problems described in the preliminary study. Some of the advantages possessed by this device are; The kit is developed by using tools and materials that are easily obtained, the existing experiments are experiments designed to be carried out by individuals so that they do not require many people/groups, the device is designed in a small size so that it can be brought home as a learning medium that can increase interest and knowledge students, with kits that can be taken home, can save time for practicum in schools that spend a lot of study time, the device is accompanied by worksheets that help students develop their process skills. As an alternative media if the school does not have a national standard light kit. Helping teachers in learning.

In the implementation of this research, from the results of the practicality assessment by the practitioner, it was obtained that in several aspects, the alternative kits and worksheets developed could only show symptoms or inculcate basic concepts regarding light and optics but have not been able to provide a deeper understanding of light material at the junior high school level. /MTS equivalent. Some experiments that are considered weak in this alternative light kit are light propagation, light reflection on a curved mirror, light refraction on the lens. Propagation of Light, experiments can only show the nature of light propagates in a straight line and penetrates a clear object. Reflection of light in

a curved mirror, experiments have not been able to provide an overview of the real or virtual properties that exist at the time of image formation by a curved mirror (spherical).

Refraction of Light in Lenses, the experiment of light refraction on the lens only shows the nature of refracting rays but does not clearly show the nature of the image formed because an image of the direction of the light is not obtained which determines the nature of the image.

4 Conclusion and Suggestions

The experimental device developed in this study consisted of alternative kits and Student Worksheets (LKS) on the subject matter of light which were packaged in small sizes so that they could be brought home as learning media. Based on the results of data collection and analysis conducted in this study, the following conclusions can be drawn; The experimental equipment developed in this study has gone through a feasibility test (empirical test of experimental device material) and has been declared feasible as an experimental device that can show symptoms in light material. This experimental device has been validated by four experts and is declared suitable for experiments that show the symptoms contained in light matter. The worksheet which was developed as an experimental guide has been validated by four experts and declared eligible with very high criteria, but for display indicators it is quite attractive with high criteria. The experimental set developed in this study had very high practicality of experiments by practitioners for all experiments, and with high scores on the worksheets for indicators of the language used being easy to understand.

The experimental device developed was appropriate as a learning medium, however, because this device was only tested in a limited group of students, it is recommended that this device can be tested again in schools during the learning process. So that all students can use it and get hands-on learning experience and proper concept understanding from this device.

References

1. Praktikum Laboratorium: Perspektif dari guru-guru Sains SMPN di kota Cimahi, *Jurnal Pengajaran MIPA*, Fakultas Pendidikan Universitas Teknologi Malaysia, Johor bahru Malaysia. (2010)
2. Trianto, *Model Pembelajaran Terpadu*, Bumi Aksara, Jakarta. (2010)
3. Irianti, M., *Pengembangan Program Pengajaran Fisika*, Cendekia Insani, Pekanbaru. (2009)
4. Sukmadinata, N., *Metode Penelitian Pendidikan*, PT Remaja Rosdakarya, Bandung. (2005)
5. Arsyad, A., *Media Pembelajaran*, Rajagrafindo Persada, Jakarta. (1996)
6. Bahri, S., *Stratregi belajar Mengajar,* Rineka Cipta, Jakarta. (2006)
7. BSNP, Standar Isi Untuk Satuan Pendidikan Dasar dan Menengah, BSNP, Jakarta. (2006,)
8. Depdiknas, *Standar Kompetensi Mata Pelajaran Fisika*, Balai Pustaka, Jakarta. (2006)
9. Djamarah, S. dan Aswan Z., *Strategi Belajar Mengajar*, Rineka Cipta, Jakarta. (2006)
10. Giancoli, D.C., *Fisika Jilid 1*, Erlangga, Jakarta. (2001)
11. Irianti, M., *Pengembangan Program Pengajaran Fisika*, Cendekia Insani, Pekanbaru. (2009)
12. Irianti, M., 2006, *Dasar-Dasar Pendidikan MIPA*, Cendekia Insani, Pekanbaru. (2009)
13. Jeperis, Studi kompetensi guru IPA Fisika SMP Negeri Kota Pontianak Dalam melakukan Praktikum di Laboratorium. (2009) http://jeperis,wordpress.com/.(Februari,2012)
14. Muslich, M., *KTSP Dasar Pemahaman dan Pengembangan*, Bumi Aksara, Jakarta. (2007)
15. Mahmudin, *Pendekatan Keterampilan Proses dalam Pembelajaran IPA* (2009) [online].http://mahmuddin.wordpress.com/2009/11/05/pendekatan-keterampilan-proses-dalam-pembelajaran-ipa/
16. Prastowo, A., *Panduan Kreatif Membuat Bahan Ajar Inovatif*, Diva Press, Yogyakarta. (2011)
17. Roestiyah, *Strategi Belajar Mengajar,* Rineka Cipta, Jakarta. (2008)
18. Sanjaya, W., Strategi Pembelajaran Berorientasi Standar Proses Pendidikan, Kencana, Jakarta. (2007)
19. Silvinia, *Pendidikan IPA*, Departeman Pendidikan Nasional, Jakarta. (2005)
20. Sudjana, N., *Media Pengajaran*, Sinar Baru Algesindo, Bandung. (2003)
21. Sudrajad, A., *Pendekatan, Strategi, Metode, Teknik, dan Model Pembelajaran* (2008), http://akhmadsudrajat.wordpress.com
22. Susilana, R. dan Cepi R., *Media Pembelajaran*, CV Wacana Prima, Bandung. (2007)
23. Sutrisno, Laboratorium Fisika Sekolah, (2006) http://file.upi.edu/Direktori/FPMIPA/JUR._PEND._FISIKA/195801071986031SUTRISNO/Perkuliahan/Bahan_ajar/Laboratorium_Fisika_Sekolah_I/LABORATORIUM_FISIKA_SEKOLAH.pdf
24. Villa, *Pengertian dan Fungsi Pendekatan*, (2011) http://www.vilila.com/2011/11/pengertian-dan-fungsi-pendekatan.html#ixzz1ybGcXjLI.
25. Wena, M., Strategi Pembelajaran Inovatif Kontemporer, Bumi Aksara, Jakarta. (2009)