ISSN (PRINT) : 2549-9955 ISSN (ONLINE): 2549-9963
JURNAL ILMIAH PENDIDIKAN FISIKA
https://ppjp.ulm.ac.id/journals/index.php/jipf/index

Tool Development Effectiveness Display Mirrors and Lenses (Multi shapes) as a Physics Learning Media with ADDIE Design

Dewi Arisanti*, Derlina, and Rahmatsyah
Physics Education Study Program, Universitas Negeri Medan, Medan, Indonesia
* dewiarisanti@man1medan.sch.id

Abstract

They were teaching aids as the indispensable components in visualizing the learning concepts to be studied, especially in learning the Physics of optical material. This makes it easier for students to describe each concept learned in their language during the visualization process. The purpose of this research is the effectiveness of multi shapes aquarium props as a learning media developed by design Analyze, Design, Development, Implementation, Evaluation (ADDIE). This study uses the Research and Development (R&D) method to assess the effectiveness of the development of teaching aids with the ADDIE design. The results showed that the effectiveness of mirror and lens teaching aids (multi shapes) based on the evaluation of classical learning using mirrors and lenses (multi shapes) props by 90% of students completed with observations of student activities of 79.67%.

Keywords: *ADDIE; Mirrors and Lenses; Optic*

Received : 24 Mei 2022
Accepted : 17 Juli 2022
Published : 17 Juli 2022
DOI : https://doi.org/10.20527/jipf.v6i2.5483

How to cite: Arisanti, D., Derlina, D., & Rahmatsyah, R. (2022). Tool development effectiveness display mirrors and lenses (multi shapes) as a physics learning media with ADDIE design. *Jurnal Ilmiah Pendidikan Fisika*, 6(2), 403-410.

INTRODUCTION

Physics is a branch of the natural sciences and is a science that was born and developed through the steps of observation, problem formulation, hypothesis formulation, hypothesis testing through experiments, drawing conclusions, and discovering theories and concepts (Agustianti et al., 2015)

Physics learning contains abstract knowledge of physics, observation activities to analyze physical phenomena related to real-life phenomena and experimental activities to foster scientific attitudes (Anjarsari, 2014)

This goal can be achieved if the learning process in the classroom takes place by involving the active role of teachers and students. Teachers as teaching staff are expected to be able to provide meaningful and innovative learning activities by applying learning methods that attract students' interest in learning (Surani & Mifthahudin, 2018)

The criteria for good learning following the Education Unit Level

Curriculum are not enough to be based on books alone, but teaching must be equipped with practical tools and connected to the surrounding environment (Hasbullah, 2006). Students will be encouraged to develop skills and scientific attitudes in learning that are useful for continuing education and living in society. Through the use of learning media, the inculcation of concepts, principles, and laws will result in effective learning. Learning that is initially felt difficult by students will become easier to understand if using interesting learning media and teaching aids (Rini, 2017)

Methods that can be used in physics lessons include demonstration and experimental methods. Demonstration and experimental methods can foster student motivation through exercises or practices (Mihardi et al., 2013). In a demonstration and experimental methods, it is undeniable that learning tools and media have a significant role in helping students understand the material. Because, without learning tools and media, students are challenging to digest the material optimally (Anjarsari, 2014)

Physics learning outcomes of students can increase by using practical learning methods. Cognitive test results, both pre-test and post-test, there are more significant differences than the results of learning physics for students who follow the practicum learning method (Gunada et al., 2017)

Tool demonstration is a learning media that can make it easy for students because a student could direct see, observe, and understand the process with actually. Several obstacles in school are often faced by students, including the difficulty of students understanding the concept of a concave mirror and a convex mirror. Tool demonstration is capable awaken motivating students to learn physics. Tool demonstration can also stimulate students to be more active in the process of learning. Becomes more interactive and not monotone. So that tool demonstration is very effective and efficient use in the learning process of physics (Kause, 2019).

Tool demonstration working as effort complete equipment needed in learning. Tool demonstration significantly supports the learning process for delivering students Becomes more active and more understand learning directly when faced with problem lessons that need to be practised for compare Among draft and practice so that they could take data in real (Kalmykova et al., 2018). For eye lesson optics, for example, the usual prop tool is an optical kit, but not all schools can have it because it is expensive, and not all skilled teachers use an optical kit (Sagala, 2012).

There is one solution for tool demonstration optics besides economical cost and easy use: multi shapes. Multi shapes are wrong; one tool demonstration on tree discussion optics made from many mirror flat so that produce mirror sunken and mirror convex as well as lens sunken and lens convex that can be used in learning physics for determining nature from mirror sunken and convex as well as lens sunken and convex. Ingredients' main maker multi shapes aquarium is mirror flat that costs relatively inexpensive compared with the optical kit in production by the factory. Use tool demonstration multi shapes could implement with learning model innovative as experiment with ADDIE learning process (Cahyadi, 2019).

ADDIE is a generative process because it applies to concepts and theories for a particular context. ADDIE is used in educational settings to build knowledge and skills during guided learning episodes (De Falco et al., 2019). Guided learning is a mutually agreed search for expectations between

students and teachers. When a person is in continuous learning, guided learning refers to the construction of knowledge that occurs in shared learning spaces. The basic principle of ADDIE is that all planned activities focus on guiding the student as he builds knowledge in several learning spaces (Branch, 2009).

Based on pre-research conducted at MAN 1 Medan results from analysis problem learning from results Interview against the MAN 1 Medan teacher that, learning physics at school still centred to the teacher, the completeness of learning media still very minimal in particular tool demonstration optics, tools demonstration available optics optical kit only and teachers rarely use optical kit the because the teacher is lacking skilled in use it. This is very implication for results study students whose average is below the minimum compliance criteria. A teacher explains that learning physics only uses method discussion.

Fact another result from observation with sharing questionnaire to a student that 75 % of students say that physics that difficult and learning in the more teacher class often explain as well as give example question only, without using learning media, resources learn what they Use only book lesson or textbook course. Limitations tool demonstration Becomes obstacles seldom did experiment or experiment. Besides the lack of infrastructure for tool demonstration optics, inhibiting factors in material delivery are also caused by a lack of Skills and teacher creativity in making tool demonstration simple.

Based on the analysis of the result, instructional obtained that tool demonstration multi shapes needed by teachers dan students as support in activity learning because tool demonstration multi-shape aquarium besides inexpensive the cost also easy to use. Tool demonstration multi-shape aquarium could be used to test mirrors and lens. MAN 1 Medan school needs a tool demonstration multi-shape aquarium as a supporting medium for learning physics.

The effectiveness of a teaching aid can be measured from the effectiveness of teaching aids in learning in the field. According to Eggen & Kauchak (Surani & Mifthahudin, 2018). Effective teaching occurs when students are actively involved in organizing and finding relationships in the information they encounter rather than being passive recipients of teacher-delivered bodies of knowledge. This activity results not only in increased learning and retention of content but also in improved thinking skills (Sani, 2014)

> *The quote above implies that effective learning occurs when students are actively involved in organizing and finding relationships with the information provided. Students do not just passively accept the knowledge conveyed by the teacher, but they can respond actively* (Surani & Mifthahudin, 2018)

Determination of the effectiveness of teaching aids is seen from the consistency of the two measurement results, namely: (1) the results of expert and practitioner assessments based on mastery of theory and experience stating that the developed teaching aids can be applied effectively in the field (in the implementation of classroom learning) and (2) the effectiveness of implementing the use of teaching aids developed in the field (implementing classroom learning) using the developed teaching aids (intended attained or IA) (Kalmykova et al., 2018). Teaching aids are said to be effective if they meet four indicators, namely the achievement of student learning outcomes, the achievement of the ideal time for student and teacher activities, the achievement of the teacher's ability to manage to

learn, and many students respond positively to the components and learning activities. Effectiveness can be analyzed by using the percentage of completeness. The media is said to be effective if 75% of students can achieve their learning objectives (Saifulloh & Darwis, 2020).

METHOD

The product development concept used by the researcher is the concept of Research & Development (R&D). The type of research used is research with ADDIE design (Analyze, Design, Development, Implementation, Evaluation) by Robert Maribe Branch (Branch, 2009). The analysis stage consists of basic physics learning problems and theoretical and empirical analysis. The design stage (planning) includes making the design multi-shapes teaching aids and compiling learning tools. The development stage includes making prototypes of multi-shape teaching aids, reviewing teaching aids, repairing props, and validating multi-shapes teaching aids (Husna et al., 2020). Implement (implementation) is a trial of teaching aids in learning at school. The evaluation stage (evaluation) is the analysis and evaluation of the results of the multi-shapes teaching aids and learning outcomes using the multi-shapes teaching aids. The research instruments used are interviews, observations, media validation questionnaires, and assessment rubrics. Data analysis in this study uses taxonomic qualitative analysis techniques, namely data collection continuously through observation, interviews, and documentation so that the data collected becomes large. This analysis describes the data's characteristics to create a better product. This way is expected to make it easier to understand the data for the following process. The design/planning made is the design of the mirror and lens props (multi shapes), as shown in Figure 1.

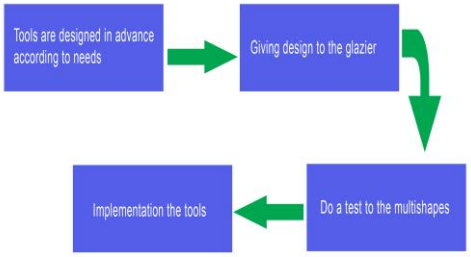

Figure 1 Steps to make multi shapes

To see the criteria for mastery learning can be seen in Table 1.

Table 1 Criteria for a complete learning

Mark Percentage	Criteria
80% < P 100%	High
65% < P 79%	Normal
P 65%	Low

RESULTS AND DISCUSSIONS

The research resulted in a product in the form of developing mirrors and lenses (multi shapes) props as props made with mirrors and thin glass. The steps for developing teaching aids use the ADDIE design, where scientific findings, especially physics, are obtained based on observations of various natural phenomena. From the observations made, it will generate curiosity which is proven based on the design of the investigation, which is then followed up to find accurate and consistent explanations of natural phenomena and can directly train and develop science process skills (Pane & Dasopang, 2017).

Analysis

The results of the analysis on the four indicators in the form of learning analysis, analysis of instructional objectives, analysis of students, and analysis of available resources resulted that the development of teaching aids was very necessary and very effective for students to use both materially and

visually as one of the development learning materials in schools.

Design

Mirror and lens props are designed to have the advantage of observing the characteristics of mirrors and lenses directly, observing the passage of special rays on mirrors and lenses directly, and determining the focal length of the mirror and lens used (Wibowo, 2014). Some schools do not yet have optical teaching aids due to optical teaching aids, which are a bit complicated and expensive. This causes optical visual aids to be rarely used when conducting trials in schools. Based on research conducted by (Anjarsari, 2014) stated that some students are using optical visual aids who still find it challenging to use them. This is in line with research (Hake, 2007) saying that optical visual aids are costly and difficult to operate.

To overcome this, researchers developed optical visual aids. Teaching aids are made by using many plane mirrors for concave and convex mirrors and glass for concave and convex lenses. The design of the props is shown in Figure 2.

Figure 2 Multi shapes prop for a convex lens seen from the side

Development

The development contains the realization of product design activities. Realization activities have several components, namely producing content/products, selecting or developing supporting media, and developing the student worksheets for students. Development is intended to revise teaching aids to be suitable for development, especially in trials with the percentage of measurement error above 5% and when the percentage of focal distance measurement error is above 5%.

Implementation

In the implementation phase, the activities are carried out to carry out learning programs by applying designs or product specifications that have been developed. The researcher's step is to use mirrors and lenses (multi shapes).

Evaluation

The results of classical student learning completeness obtained results of 90% of students completing the given evaluation. The description of students' learning mastery results classically is shown in the following Figure 3.

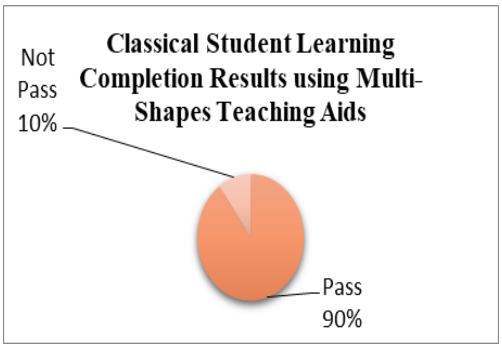

Figure 3 The results of classical student learning completeness

The Figure 3 shows that 36 out of 40 students (90%) achieved a completeness score, so only 10% of students were declared incomplete. If we refer to the classical student mastery criteria, namely, at least 85% of students who take part in the learning can achieve a score of 85, and it can be concluded that the post-test results of classical student learning completeness have met the effective criteria for achieving classical mastery.

Effectiveness Level Analysis Tool Display

The effectiveness of props is related to student learning results based on the achievement of classical student learning mastery. The data obtained from the post-test results after using tool demonstration Multi -shapes at the end of each trial were analyzed to determine the percentage of students who had mastered the concept (Saifulloh & Darwis, 2020). The criteria that state students are said to have been able to understand the concept well if there are 85% of students who take the test can have a minimum score of 75 (Pane & Dasopang, 2017).

Study Time Analysis and Activity Student

Learning time with tools developed props through ADDIE design as much as 3 x meeting or about 3 x 45 minutes. The ADDIE learning model is student-centred and can facilitate students in developing the scientific process based on systematic stages (De Falco et al., 2019). To analyze the learning time is done by seeing whether the time that has been designed is more than or equal to the time required for the moment of learning carried out by the teacher without using multi-form teaching aids. To find out the activities of students through real observers when learning using multiform teaching aids is carried out. Student activities are all carried out in or outside the classroom when the learning process occurs, whose output is a behaviour that can influence/change student learning outcomes (Komyadi & Nasution, 2015). The test results in the implementation phase of the mirror and lens props (multi shapes) have met the effective category in terms of classical student learning completeness and student activities within the established ideal time tolerance limit.

The results of the post-test analysis in the implementation phase to students in one class with a total of 40 students with 36 of 40 students (90%) achieving a complete score, so only 10% of students were declared incomplete. If we refer to the classical student mastery criteria, namely, at least 85% of students who take part in the learning can achieve a score of 85, and it can be concluded that the teaching aids already have proper effectiveness for use because classical student learning completeness in 85% of students in one class get minimum score value.

Students also gave positive comments, with most saying that learning by using visual aids helps them better understand the material being studied; this is to research by (Husna et al., 2020) that teaching aids help students to make it easier to understand a concept being taught.

Another similar research, namely research by (Shobrina et al., 2020), states that the development of visual aids, especially on optical material, is essential, especially in completing students' knowledge so that they are more conceptual when linked in terms of visuals (Husna et al., 2020).

When viewed, the student's activity met the ideal time set criteria. So it can be concluded that students' activities using mirrors and lenses have met the effective criteria so that the ideal time for using teaching aids and without using props is the same. This information illustrates that when learning, students are active and have high enthusiasm for participating in learning by using teaching aids, so students use teaching aids more often based on the worksheets distributed during learning.

CONCLUSION

Based on the results of the study, it was found that the effectiveness of mirror and lens teaching aids (multi shapes) based on the evaluation of classical learning using mirrors and lenses (multi

shapes) props by 90% of students completed. The result of observing student activity is 79.67%. For the following research, it is suggested that the research be carried out more complexly with a broader research object so that the coverage of the indicators taken can represent all aspects and respondents.

ACKNOWLEDGMENTS

I would like to thank my parents, husband and beloved children, who have provided moral and material support so that I can complete this thesis on time. I would like to thank Mr Dr. Rahmadsyah, M.Si and Mrs Dr. Derlina, M.Si as supervisors who have always provided direction and guidance to the author in completing the writing of this thesis. Thank you to Mrs Maisaroh, S.Pd, M.Si as the Head of MAN 1 Medan, who has supported the morally and materially to the author from the beginning of the research to the end. Thanks to Mr Pandapotan Hrp S.Pd, MPmat, as a validator for his input and criticism so that the author can complete the writing of this thesis. Thank you to the students of MAN 1 Medan who has helped the writer in the process of writing this thesis. Thank you to Putri Srijayanti M.Pd, Masringgit Marwiyah Nst, M.Pd, Naimah Nasution M.Pd, Rifka Annisa Girsang, M.Pd for their help and support so that the author can complete this thesis properly and correctly.

REFERENCES

Agustianti, D., Rustana, C. E., & Nasbey, H. (2015). *Pengembangan alat praktikum melde sebagai media pembelajaran fisika sma Snf2015-Ii-45 Snf2015-Ii-46*. *IV*, 45–48.

Anjarsari, P. (2014). Literasi sains dalam kurikulum dan pembelajaran IPA SMP. *Prosiding Semnas Pensa VI" Peran Literasi Sains" Surabaya*, *20*.

Branch, R. M. (2009). *Instructional design: The ADDIE approach* (Vol. 722). Springer Science & Business Media.

Cahyadi, R. A. H. (2019). Pengembangan bahan ajar berbasis ADDIE model. *Halaqa: Islamic Education Journal*, *3*(1), 35–42.

De Falco, S., Angelidou, M., & Addie, J.-P. D. (2019). From the "smart city" to the "smart metropolis"? Building resilience in the urban periphery. *European Urban and Regional Studies*, *26*(2), 205–223.

Gunada, I. W., Sahidu, H., & Sutrio, S. (2017). Pengembangan Perangkat Pembelajaran Fisika Berbasis Masalah untuk Meningkatkan Hasil Belajar dan Sikap Ilmiah Mahasiswa. *Jurnal Pendidikan Fisika Dan Teknologi*, *1*(1), 38–46. https://doi.org/10.29303/jpft.v1i1.233

Hake, R. R. (2007). Design-based research in physics education: a review. *Handbook of Design Research Methods in Education*, 16.

Hasbullah, D. (2006). dasar Ilmu Pendidikan, edisi revisi. *Jakarta: Raja Grafindo Persada*.

Husna, A., Hasan, M., Mustafa, M., Syukri, M., & Yusrizal, Y. (2020). Pengembangan modul fisika berbasis integrasi Islam-sains pada materi gerak lurus untuk meningkatkan hasil belajar peserta didik. *Jurnal Pendidikan Sains Indonesia*, *8*(1), 55–66.

Kalmykova, Y., Sadagopan, M., & Rosado, L. (2018). Circular economy–From review of theories and practices to development of implementation tools. *Resources, Conservation and Recycling*, *135*, 190–201.

Kause, M. C. (2019). Rancang Bangun

Alat Peraga Fisika Berbasis Arduino (Studi Kasus Gerak Jatuh Bebas). *Cyclotron*, *2*(1).

Komyadi, & Nasution, D. (2015). Penerapan media simulasi phet untuk meningkatkan aktivitas siswa pada fase pengumpulan data percobaan dan mengolah serta merumuskan suatu penjelasan dalam model pembelajaran inquiry training di sma negeri 5 takengon. *Jurnal Pendidikan Fisika*, *4*(1), 1. https://doi.org/10.22611/jpf.v4i1.2562

Mihardi, S., Harahap, M. B., & Sani, R. A. (2013). The effect of project based learning model with kwl worksheet on student creative thinking process in physics problems. *Journal of Education and Practice*, *4*(25), 188–200.

Pane, A., & Dasopang, M. D. (2017). Belajar dan pembelajaran. *Fitrah: Jurnal Kajian Ilmu-Ilmu Keislaman*, *3*(2), 333–352.

Rini, D. E. P. (2017). Pengembangan alat peraga rel osilasi kelereng untuk menentukan percepatan gravitasi dalam menunjang pembelajaran fisika pada materi getaran harmonis. *Inovasi Pendidikan Fisika*, *5*(3), 64–68.

Sagala, S. (2012). *Supervisi Pembelajara dalam Proses Pembelajaran*. Bandung: Alfabeta.

Saifulloh, A. M., & Darwis, M. (2020). Manajemen pembelajaran dalam meningkatkan efektivitas proses belajar mengajar di masa pandemi covid-19. *Bidayatuna Jurnal Pendidikan Guru Mandrasah Ibtidaiyah*, *3*(2), 285–312.

Sani, R. A. (2014). *Pembelajaran saintifik untuk implementasi kurikulum 2013*. Bumi Aksara.

Shobrina, N. Q., Sakti, I., & Purwanto, A. (2020). Pengembangan desain bahan ajar fisika berbasis e-modul pada materi momentum. *Jurnal Kumparan Fisika*, *3*(1 April), 33–40.

Surani, D., & Mifthahudin, M. (2018). Kompetensi guru dan motivasi mengajar guru berpengaruh terhadap efektivitas pembelajaran di smk negeri 3 kota serang. *Tarbawi: Jurnal Keilmuan Manajemen Pendidikan*, *4*(02), 149–158.

Wibowo, W. S. (2014). Implementasi model project-based learning (pjbl) dalam pembelajaran sains untuk membangun 4cs skills peserta didik sebagai bekal dalam menghadapi tantangan abad 21. *Seminar Nasional IPA V*, 275–286.