Multimedia Learning Modules Development based on Android Assisted in Light Diffraction Concept

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Multimedia Learning Modules Development based on Android Assisted in Light Diffraction Concept

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Abstract: This paper develops learning tools in the form of lesson implementation plans (RPP), modules, and assessment sheets. RPP has been developed with a model of guided inquiry as a means of learning activities. The modules are developed in the form of Multimedia Learning Modules (MLMs) which can attract the interest and motivation of students. The assessment sheet developed is an assessment of mathematical and verbal abilities. The results of the validation of the products developed show that the criteria are very feasible to be used in learning activities.

Keywords: Lesson implementation plans; Multimedia learning modules; Mathematical and verbal assessment sheets.

1. Introduction

Rapid technological developments make learning activities more challenging for students. The Republic of Indonesia Minister of Education and Culture Regulation Number 22 Year 2016 states that learning must be carried out interactive, inspirative creative, fun and challenging. Challenging and creative learning encourages students' motivation to learn more in a material concept.

Learning changes concept understanding through the transfer process, understanding, predicting, solving problems, and translating [1]. Learning is said to be successful if students are able to understand the concept of the material well [2]. In the process of improving learning outcomes, many learning models that can be used include guided inquiry models. Guided inquiry method is used in the learning process because it is considered to be able to improve students' understanding of concepts, techniques, and process skills [3].

Learning activities require learning tools as teaching guidelines. Learning tools used use a variety of learning models for the teaching process. The learning model that can be applied in a learning tool among them is inquiry because it helps students to investigate natural phenomena that occur [4]. The guided inquiry model has six syntaxes that can be used in learning activities including the presentation of problems in general, choosing specific topics, exploring information, formulating problems, collecting data and conveying the results of data analysis [5].

The model of guided inquiry in learning activities can be applied using a variety of module assisted approaches. The results show that the guided inquiry model applied in the module can help students analyze the concept of the material as a whole [6]. This shows that the module-assisted learning device can be used to measure the learning outcomes of students [7]. However, some of the modules used in learning activities are still at the planning and starting level [8]. Therefore, a more interactive, innovative and creative module is needed to be used in learning activities. Learning by applying modules provides a positive influence for students because it provides a solution to the use of text books that are less effective [9-11].

Interactive, innovative and creative modules can be developed into interactive multimedia forms by inserting text, audio, video, animation and narration [12]. Learning by implementing interactive multimedia can improve students' conceptual understanding [13]. The multimedia module developed is known as Multimedia Learning Modules (MLMs) by combining graphics, audio, narration, video and text features into various forms of representation [10, 14-17]. The results of the study state that the use of MLMs in learning activities can reduce the limitations of the use of textbooks [10,18].

MLMs in learning activities are combined with Tracker software as software for analyzing videos. Tracker acts as a video analysis to mark objects in slow motion and modeling data in the form of graph analysis so that the equation of the line is obtained [19]. Software Tracker in learning activities has an attraction for students to learn material by understanding the results of their analysis [20].

This paper discusses the development of MLMs, Learning Implementation Plans (RPP), and mathematical and verbal ability assessment sheets that are integrated with Tracker software.

The rest of this paper is organized as follow: Section 2 presents literature review. Section 3 describes the proposed research method. Section 4 presents the obtained results and following by discussion. Finally Section 5 concludes this work.

2. Related Works

Learning is defined as the process of changing a person's behavior and capacity derived from the experience gained [21]. Learning is closely related to the environment where the learning process takes place [22]. A learning environment that has a pedagogical concept, a systematic curriculum design and a comfortable learning atmosphere can make the process of finding knowledge more effective [23]. Minister of Education and Culture Regulation of the Republic of Indonesia Number 22 Year 2016 concerning Standard Process of Primary and Secondary Education states that the learning process must be held interactively, innovatively, creatively, challenging and fun.

Physics is one of the learning activities that can be held creatively, innovatively and fun. Physics focuses on quantitative discussion in finding and finding basic laws related to phenomena in the natural environment [24]. Fun physics learning can occur if the tools and media used can improve understanding of concepts, attract students' interest and motivation to learn [15,25,26].

Learning tools that can be applied in learning activities must choose the appropriate learning model. Such learning models include guided inquiry [6,27]. Guided inquiry is a popular model in science learning. Guided inquiry consists of a process of orientation, conceptualization, investigation, concluding and discussion or discussion [28]. Learning to use the guided inquiry model is more effective when applying the module as a medium of assistance in the learning process. The guided inquiry model applied in the learning module can help students to analyze the overall material concept [6].

The module is a complete teaching material that is used in learning activities as assistance for students to achieve learning goals. The functions of modules in learning activities include teaching materials, substitutes for educators as facilitators, evaluation tools and as a theoretical study material for students [29]. The module has the characteristics of self-contained, user friendly, stand alone, self-instructional, and adaptive [30]. The use of modules in learning activities is more interesting and fun when packaged in the form of interactive multimedia. The results of the study stated that the application of multimedia in learning activities had a positive impact on the process of information retrieval, showed a real simulation and provided visual literacy for students [31]. The use of modules in learning activities is more interesting and fun when packaged in the form of interactive multimedia. The results of the study stated that the application of multimedia in learning activities had a positive impact on the process of information retrieval, showed a real simulation and provided visual literacy for students [14,19].

Multimedia Learning Modules (MLMs) are introductory media that aim to motivate students to actively participate in learning activities [10,32]. The MLMs in the form of unity between video, audio, text, narration, and animation are packaged in various forms of representation with the aim of reducing the ineffectiveness of the use of textbooks [10,14,16,18]. The process of making MLMs consists of five stages including understand, design, build, Test and Evaluation, and Improve [33]. The MLMs apply various representations including animations, videos, audio and narratives that make it more interactive

[14,15,17,34]. Representations provided by MLMs such as videos provide a positive influence for students in accessing information so as to increase students' conceptual understanding [25,26]. The video used as a representation is combined with Tracker software as a video analyst, making it easier for students to understand the concepts taught [19,35,36].

3. Material & Methodology

This research includes research and development using a modified 4-D model developed by Thiagarajan in 1974 [37]. The stages of this study include the stages of define, design, develop, and disseminate. The 4-D model modified to 3-D is shown in Figure 1. The study was conducted in MAN 2 Yogyakarta on April 28, 2018 with a total of 29 students. Products produced are MLMs which are equipped with light diffraction video illustrations, RPP, Assessment Sheets and LKS. The multimedia module developed was opened using the *Himawari Reader* application. Display of multimedia modules produced as shown in Figure 2.

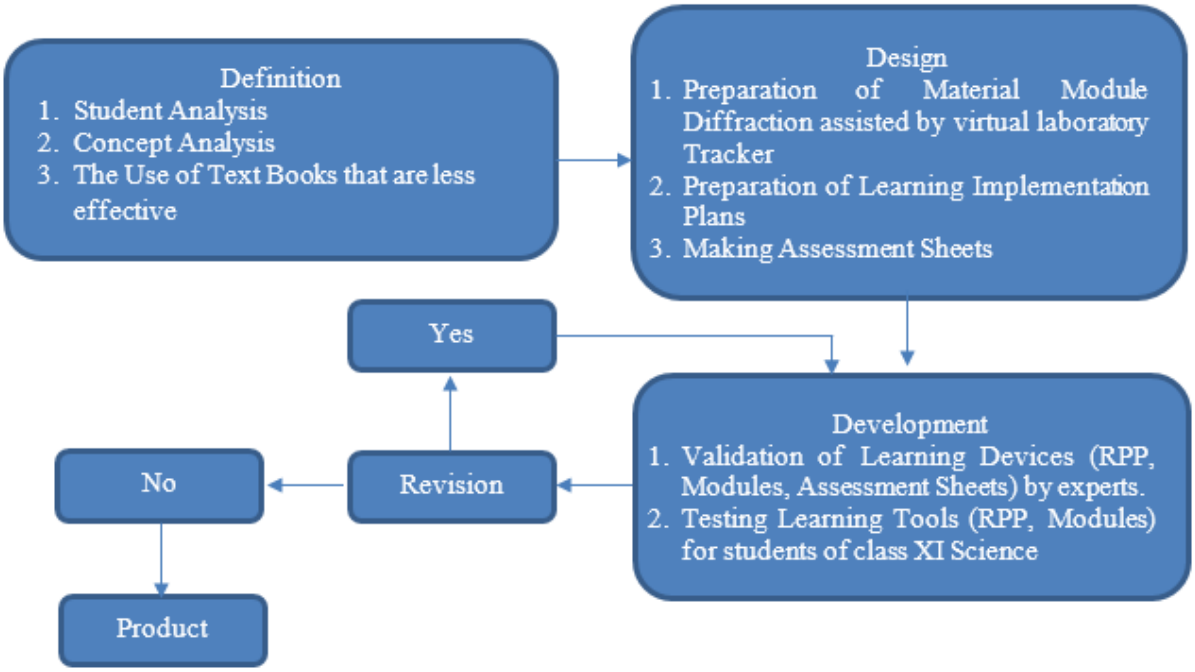

Figure 1. Flowchart of MLMs Development

Figure 2. Display of Multimedia Learning Modules

The type of data produced in this study is quantitative data. The instrument used in this study is an expert validation sheet. The results of the assessment data are scores which are then converted into a scale of 5 according to the Likert scale.

The feasibility of multimedia learning modules (MLMs) that will be used in learning is analyzed from the media quality category. Multimedia learning modules (MLMs) are considered appropriate if they obtain a minimum of good quality categories. Quality categories of multimedia learning modules (MLMs) are obtained from media validation data by validators. Media validation data in the form of quantitative data with a score range of 1-5. Data were analyzed following steps

a) Determine the percentage of each score [38]

$$P = \frac{f}{N}\ 100\% \quad (1)$$

Where:
P is Percentage
f is Number of score obtained in each aspect
N is Frequency of total or total number of subjects

b) The mean score of each item for all aspects of product valuation is calculated based on the total score of the overall assessment aspect divided by the number of assessors

$$\bar{X} = \frac{\sum X}{n} \quad (2)$$

$\bar{X}$ is Average Score
$\sum X$ is Total Score
n is Number of Assessors

c) Compare the mean scores with criteria according to [39] (see Table 1).

Table 1. Average Interval Conversion Questionnaire Quality Criteria

No	Score Range (i)	Category	Value
1	$\bar{z} \geq z_i + 1{,}8\ Sbi$	Very Good	A
2	$z_i + 0{,}6\ Sbi < \bar{z} \leq z_i + 1{,}8\ Sbi$	Good	B
3	$z_i - 0{,}6\ Sbi < \bar{z} \leq z_i + 0{,}6\ Sbi$	Pretty Good	C
4	$z_i - 1{,}8\ Sbi < \bar{z} \leq z_i - 0{,}6\ Sbi$	Less	D
5	$\bar{z} \leq z_i - 1{,}8\ Sbi$	Very Less	E

Information:
$\bar{z}$ is Mean Score
z_i is Mean Ideal Score

$$z_i = {}^1/_2\ (Ideal\ Maximum\ Score + Ideal\ Minimum\ Score)$$

Sbi is Standard Deviation of Ideal Score

$$Sbi = {}^1/_5\ (Ideal\ Maximum\ Score - Ideal\ Minimum\ Score)$$

4. Results and Discussion

The results of this study are product development and expert validation results. Expert validation includes RPP validation, validation of assessment sheets for mathematical and verbal representations, validation of MLMs and validation of LKS sheets. The Lesson Implementation Plan (RPP) is assessed by following the aspects of formulating learning objectives, content presented, language and time. RPP developed using guided inquiry learning model that includes learning stages includes the orientation

process stage, modified conceptualization into data collection and verification, modified investigation into data collection through experiments, concluding modified into explanatory formulations and modified discussions or discussions into inquiry analysis [28]. The inquiry model was chosen because it can help students investigate natural phenomena around [4]. The results of expert validation obtained a percentage of 85% for the aspect of the formulation of learning objectives, the percentage of 90% for the aspect of content presented, the percentage of 75% for aspects of language and 100% for the aspect of time. Figure 3 shows the percentage of RPP assessment based on assessment aspects.

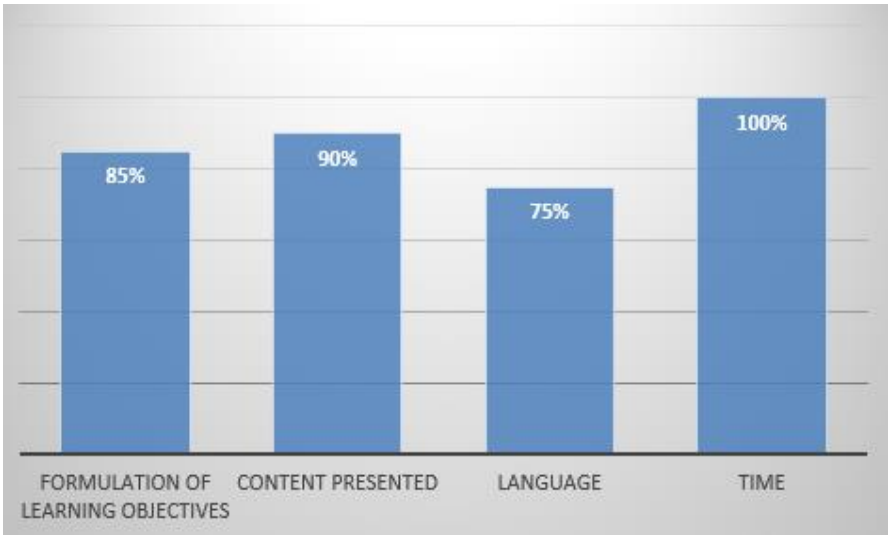

Figure 3. Percentage of RPP Validation Results

The results of expert validation stated that the RPP was in good criteria for use in learning activities. This agrees with the results of the study [6] which states that the guided inquiry model applied in the learning device can help the learning process of students to analyze the material as a whole. The results of the RPP validation are presents in Table 2.

Table 2. Average Assessment Score of RPP

Number	Assessment Aspect	Average Score
1	Formulation of Learning Objectives	17
2	Content presented	18
3	Language	9
4	Time	8
Total Score		52
Ideal Maximum Score		60
Ideal Minimum Score		15
Average Ideal Score		37,5
Standard Deviation of Ideal Score		9
Values and Categories		**B (Good)**

The assessment sheet developed is an assessment of mathematical and verbal representations that refer to the syntax of the guided inquiry model. Aspects assessed include the format of assessment, guidelines for scoring, use of language rules and linkages with the material. The results of expert validation on the assessment sheet of mathematical and verbal representations obtained a percentage of 88% for aspects of the assessment format, the percentage of 75% for aspects of scoring guidelines, the

percentage of 75% for aspects of the use of language rules and 100% for aspects of linkages with the material. The results of the validation of the assessment sheet are presented in Figures 4 and 5.

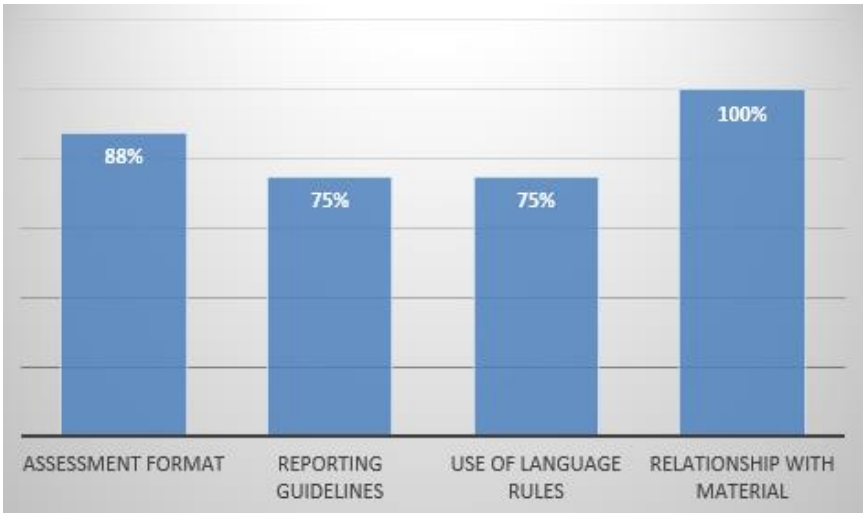

Figure 4. Percentage of Validation Results Assessment Sheet Mathematical Representation

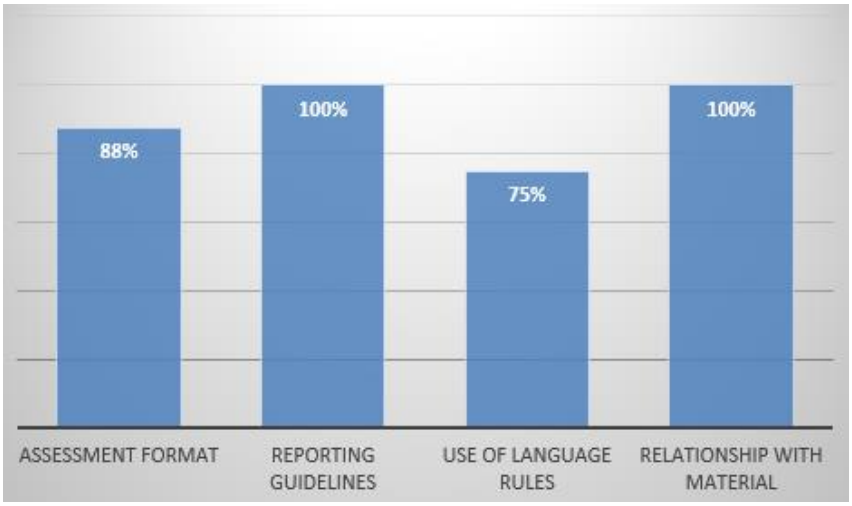

Figure 5. Percentage of Validation Results Verbal Representation Assessment Sheet

The results of expert validation stated that the assessment sheet of mathematical and verbal representations was in good criteria to be used to assess students' mathematical and verbal abilities in learning activities. Tables 3 and 4 present the mean validation scores for mathematical and verbal assessment sheets.

Table 3. Average Scoring Scores of Mathematical Assessment Sheets

Number	Assessment Aspect	Average Score
1	Assessment Format	14
2	Reporting Guidelines	3
3	Use of Language Rules	12
4	Relationship with Material	4
Total Score		33
Ideal Maximum Score		40

Ideal Minimum Score	10
Average Ideal Score	25
Standard Deviation of Ideal Score	6
Values and Categories	**B (Good)**

Table 4. Average Scoring Scores of Verbal Assessment Sheets

Number	**Assessment Aspect**	**Average Score**
1	Assessment Format	14
2	Reporting Guidelines	4
3	Use of Language Rules	12
4	Relationship with Material	4
Total Score		34
Ideal Maximum Score		40
Ideal Minimum Score		10
Average Ideal Score		25
Standard Deviation of Ideal Score		6
Values and Categories		**B (Good)**

The resulting assessment sheet refers to the syntax of the guided inquiry learning model so that it is expected to be able to assess students' mathematical and verbal abilities. The results of the study stated that the application of the guided inquiry model in the learning tool can help analyze the ability of students in investigating the overall material concept [6]. This is in line with the Minister of Education and Culture Regulation Number 22 Year 2016 concerning the Process Standard of Primary and Secondary Education which states that learning must be carried out creatively, innovatively, challenging and fun. This fun and challenging learning is accompanied by interesting learning tools and appropriate evaluation tools [30].

The modules are developed in the form of MLMs with light diffraction material containing features of graphics, text, video, animation and narration [14,15,16,17]. Modules were developed using SIGIL software to be further applied to android smartphones. The MLMs are chosen because they can reduce the limitations of using textbooks [10,18]. The Multimedia Learning Modules that were developed were assessed based on the structural aspects of the module, the organization of material writing and the use of language [30]. The results of the validation of the structural aspects of the module obtained a percentage of 92%, material organizational aspects 81% and 75 %% on aspects of language as presented in the diagram in Figure 6.

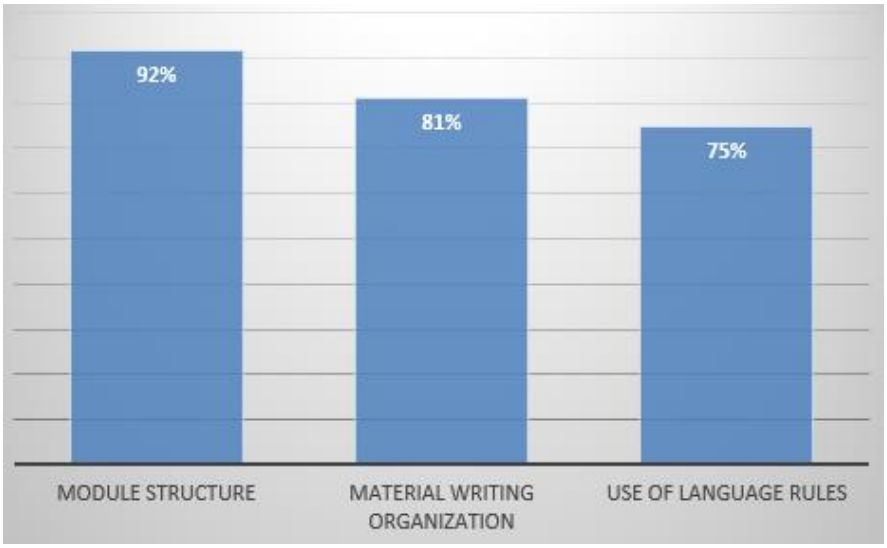

Figure 6. Percentage of Validation Results for Multimedia Learning Modules (MLMs)

Validation results show that multimedia learning modules (MLMs) are in a good category for use in learning. Modules that are suitable for use in learning must have the characteristics of self-contained, user friendly, stand alone, self-instructional, and adaptive [30]. Module characteristics are inserted in interactive multimedia so that multimedia learning modules (MLMs) become more attractive and motivate students to learn more in the concept of the material provided. The results of the study stated that learning activities were more interesting and had a positive influence on students by implementing multimedia learning modules (MLMs) in them [15,25]. This opinion is supported by the results of other studies which state that the application of interactive multimedia in learning activities can improve understanding of the material concepts of students [13]. Table 5 presents the mean scores for assessing multimedia learning modules (MLMs).

Table 5. Average Score of Assessment of Multimedia Learning Modules (MLMs)

Number	**Assessment Aspect**	**Average Score**
1	Module Structure	11
2	Material Writing Organization	13
3	Use of Language Rules	9
Total Score		33
Ideal Maximum Score		40
Ideal Minimum Score		10
Average Ideal Score		25
Standard Deviation of Ideal Score		6
Values and Categories		**B (Good)**

5. Conclusion

The results of the research and development resulted in (1) products in the form of learning media consisting of Lesson Implementation Plans (RPP), multimedia learning modules (MLMs) light diffraction, and assessment sheets of mathematical and verbal abilities that matched the syntax of guided inquiry learning models which included presenting problems general, choosing specific topics, exploring information, formulating problems, collecting data and conveying the results of data analysis. (2) The results of the evaluation by expert validators showed that the learning tools that were developed included Lesson Implementation Plans (RPP), multimedia learning modules (MLMs) light diffraction, and mathematical and verbal ability assessment sheets categorized as good so that they were suitable for use in learning activities.

Based on the conclusions above, the recommended suggestion is to implement multimedia learning modules (MLMs) in physics learning activities, because it can attract students' interest and motivation in learning activities.

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