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Development of Interactive Electronic Modules (e-Modules) based on Flip PDF Corporate Edition on the Subject of IPA Class V Elementary School Heat Transfer Material

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Abstrak

Penelitian ini dilakukan untuk menjawab adanya kebutuhan akan bahan ajar elektronik terkini, interaktif dan memudahkan pembelajaran bagi guru dan siswa kelas V sekolah dasar, terutama di era Revolusi 4.0. Tujuan utama penelitian ini yaitu untuk mengetahui prosedur pengembangan dan kelayakan modul elektronik interaktif berbasis *Flip PDF Corporate Edition* untuk pembelajaran IPA di Kelas V Sekolah Dasar Materi Perpindahan Kalor. Penelitian ini merupakan jenis penelitian bermetode *Research and Development* (R&D) dengan model pengembangan ADDIE. Data dihimpun melalui angket, wawancara, observasi, dan dokumentasi. Penelitian ini menghasilkan bahan ajar yang dikembangkan dengan *Flip PDF Corporate Edition* berupa modul elektronik interaktif yang berisi teks, gambar, audio visual, dan *game*.Validasi oleh dosen ahli dilaksanakan sebanyak dua kali. Hasil akhir validasi tiga dosen ahli (materi IPA, media, dan desain) adalah 100% yang artinya modul elektronik dapat digunakan tanpa revisi. Hasil akhir validasi oleh dosen ahli bahasa adalah 86,67% yang artinya modul elektronik dapat digunakan dengan revisi minor. Hasil uji coba kelompok kecil terhadap modul elektronik yang diuji coba adalah 91,67% yang artinya modul elektronik dapat digunakan dengan revisi minor. Hasil uji coba lapangan terhadap modul elektronik yang diuji coba adalah 86,83% yang artinya modul elektronik dapat digunakan dengan revisi minor. Perbandingan hasil uji coba kelompok kecil dan uji coba lapangan adalah 88,99%, yang artinya modul elektronik dapat digunakan dengan revisi minor dalam kegiatan pembelajaran dengan indikator tertinggi yakni kehadiran modul elektronik memudahkan pembelajaran bagi guru dan siswa kelas V sekolah dasar.

Kata kunci: bahan ajar, modul elektronik, IPA, *Flip PDF Corporate*, ADDIE

Abstract

This research was conducted to answer the need for the latest electronic teaching materials, interactive and facilitating learning for teachers and grade V elementary school students, especially in the era of Revolution 4.0. The main purpose of this study is to determine the development procedures and feasibility of interactive electronic modules based on Flip PDF Corporate Edition for learning science in Class V Elementary School on Heat Transfer Material. This research is a type of Research and Development (R&D) method with the ADDIE development model. Data were collected through

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questionnaires, interviews, observations, and documentation. This research produces teaching materials developed with Flip PDF Corporate Edition in the form of interactive electronic modules containing text, images, audio visuals, and games.Validation by expert lecturers was carried out twice. The final result of validation by three expert lecturers (science material, media, and design) was 100%, which means that the electronic module can be used without revision. The final result of validation by language expert lecturers is 86.67% which means that the electronic module can be used with minor revisions. The results of the small group trial of the electronic module tested were 91.67%, which means that the electronic module can be used with minor revisions. The results of the field trial of the electronic module tested were 86.83%, which means that the electronic module can be used with minor revisions. The comparison of the results of the small group trial and the field trial is 88.99%, which means that the electronic module can be used with minor revisions in learning activities with the highest indicator, namely the presence of electronic modules facilitates learning for teachers and students in grade V elementary school.

Keywords: teaching materials, electronic modules, science, *Flip PDF Corporate*, ADDIE

Introduction

Learning is a step in implementing the curriculum by influencing students so that educational goals are achieved. (Herawati & Muhtadi, 2018). The continuity of learning activities during the pandemic has led the Ministry of Education and Culture to adopt a Distance Learning policy to prevent the transmission of the Covid-19 virus in the school environment. (Kusyanti, 2021). In addition, the advancement of the Industrial Revolution 4.0 era in the field of ICT is also aligned with technological advancements in the field of education, making it possible for online learning to replace face-to-face teaching and thereby improving access to educational resources. (Hapudin, 2019). The ability to adapt and innovate is a demand that must be fulfilled by educators in implementing Distance Learning policies in the era of the Industrial Revolution 4.0.(Kuswanto, 2019).

Analysis of preliminary studies in the form of distributing questionnaires and interviews conducted by researchers to teachers who teach thematic material for grade V in an elementary school in the Cipondoh - Tangerang area states that there are several obstacles faced by teachers during PJJ, including device constraints, internet signals, students who are less focused on participating in learning activities, and the learning material has not been conveyed optimally even though the teacher has used media or teaching materials that are in accordance with the material.

The field of science in primary schools that offers students the opportunity to broaden their horizons, learn new skills, and use technology in everyday life is science. (Wardani & Syofyan, 2018) with the essence of natural events, living things, and non-living things around us (Syofyan et al., 2019). In primary school science learning, process skills are emphasised rather than content mastery. (Syofyan & Soraya, 2018). However, many abstract scientific concepts cause difficulties in understanding the material for students. (Nugroho, 2016). This is confirmed by the analysis of a preliminary study of students in an elementary school in the Cipondoh - Tangerang area through interviews which stated that some students had difficulty in participating in science learning because of the amount of memorisation.

The main thing that educators need to prepare as a bridge to these difficulties is

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teaching materials. (Syofyan et al., 2019). Distance Learning (PJJ) activities require teachers to systematically assemble and collect teaching materials from various sources to support PJJ activities. (Kuswanto, 2019).

The results of interviews and questionnaires for the preliminary study analysis stated that the teaching materials found and used by teachers were printed books from publishers, summaries/summaries/handouts, learning videos and Power Point. Other findings from the results of interviews and questionnaires stated that teachers felt that the teaching materials used still did not provide maximum results in delivering learning materials. Teachers expressed their desire for the availability of teaching resources that are interesting, up-to-date, and simple to use by KBM actors. Teachers also yearn for the availability of teaching materials that can foster a more interactive relationship between teachers and learners. This shows the urgent need for the education sector to adapt to the Industrial Revolution 4.0 in ICT. (Hapudin, 2019).

Teaching modules are effective materials for developing competence and assessing learning needs. (Zinnurain, 2021). Learning modules help students find need-based information on each topic (Syofyan et al., 2019). Electronic modules are modules that can be used by teachers to deliver learning materials during distance learning. (Sofyan et al., 2020), especially in the era of the Industrial Revolution 4.0 where there are technological advances in the field of education in the form of increased access to educational resources (Hapudin, 2019).

During the PJJ period, electronic modules are a good alternative teaching material because they allow the delivery of learning content without time and space constraints, allow the use of various internet-connected devices, allow relatively easy updating of learning materials, and allow student independence in implementing learning content. (Pujiasih, 2020). The results of interviews conducted with representatives of grade V students at an elementary school in the Cipondoh-Tangerang area also stated that they were interested in the use of teaching materials in the form of electronic modules.

Based on the description of the problem above, a modern, easy-to-use, and interactive teaching material is needed that can be used by teachers and students in learning activities. So, researchers make teaching materials in the form of interactive electronic modules (e-modules) based on Flip PDF Corporate Edition to answer these needs.

Method

Researchers used the Research and Development (R&D) method with the ADDIE development model. The R&D method is carried out by exploring existing products (Sinta & Syofyan, 2020) and validate a product that is developed (Nurbaeti, 2019).

The research objectives are to obtain the development syntax and explore the suitability of the interactive electronic module based on Flip PDF Corporate Edition for science learning which focuses on the material of Heat Transfer in Class V SD. Data was collected through questionnaires, interviews, observations, and documentation. Research tools in the form of classroom observation sheets, questionnaires of teaching materials / learning media used by teachers, teacher and learner interview guidelines, material expert validation instruments, and teacher

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and learner response instruments to the electronic modules that were tested.

Results and Discussion

Needs Analysis Stage (Analysis)

The first stage (Analysis) was conducted in an elementary school in the Cipondoh - Tangerang area. The researcher made observations in one of the fifth grade classes. The teacher who teaches thematic material and students were asked to fill out a questionnaire. The first stage produced needs analysis data. The needs successfully analysed by researchers are (1) the need for the development of modern, easy-to-use, and interactive electronic teaching materials that can be used by thematic material teachers and grade V students at an elementary school in the Cipondoh - Tangerang area; (2) the need for learning materials that are in accordance with the curriculum and lesson plans that apply in the classroom according to the research time, namely theme 5F Curriculum 2013 semester II material on Heat Transfer; and (3) revolution 4. 0 and the environment where the availability of learning facilities and infrastructure at an elementary school in the Cipondoh - Tangerang area supports the use of technology that is able to answer the need for the latest teaching materials and learning materials. Product Design Stage according to Needs (Design). The second stage is product design according to needs (Design). This stage is used to make the initial design of the product to be developed. (Kurnia et al., 2019) and must match the needs (Sugiyono, 2019). The steps taken by researchers to design products as needed are (1) determining core competencies, basic competencies and indicators in accordance with the curriculum, lesson plans, and lesson plans that apply in an elementary school in the Cipondoh - Tangerang area, namely Theme 5F Heat Material and Its Transfer; (2) making a flowchart of material to produce the concept and arrangement of material in the electronic module to suit the needs analysis of teachers and students as users of electronic modules; (3) designing the initial design of the electronic module as well as other supporting media in accordance with the flowchart of material that has been made from PPT format to PDF format; (4) designing a draft of the electronic module from PDF format to Flip PDF Corporate format; (5) making an evaluation strategy after using the electronic module. An example can be seen in Figure 1:

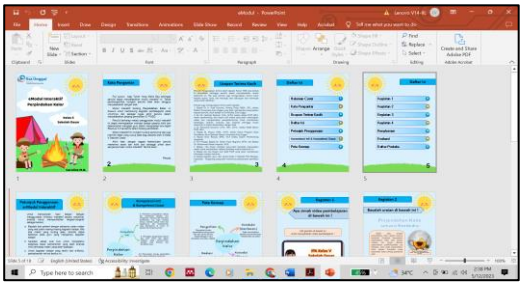

Figure 1: Example of steps to design the initial product design

Product Creation and Testing Stage (Development)

The third stage is the manufacture and testing of electronic modules (Development). Researchers create and modify the product (Cahyadi, 2019) and validate the product (Sugiyono, 2019). The initial product design at the Analysis and Design stages was realised at the Development stage. (Aminah, 2018). The steps taken by researchers at this stage are (1) developing Flip PDF Corporate products by adding You Tube links for learning videos, Liveworksheet links for evaluation, and auto download links for spin games; (2) validation/assessment of expert lecturers including material experts, media experts, design experts, and linguists; (3) design revision. Can be seen in Figure 2 and Figure 3:

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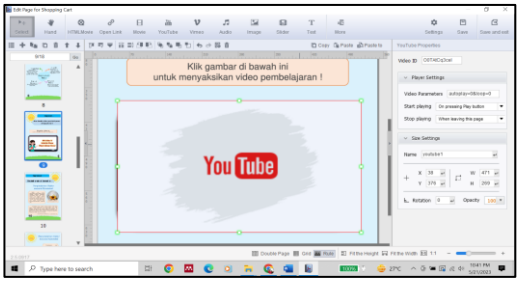

Example of steps to develop Flip PDF Corporate products by adding You Tube links for learning videos

Example of steps to develop Flip PDF Corporate products by adding links for spin games

Assessment by science material experts occurred once. The results of the validation of the science material expert lecturer were 100%, which means that the electronic module can be used without revision. Can be seen in Table 1:

Table 1. Science Material Expert Assessment Results

No.	Indicator Scoring	Score
1.	Compliance with learning objectives	3
2.	Completeness of material content in accordance with KD	3
3.	Clarity of teaching materials	3
4.	Clarity of instructions for use for users	3
5.	The conciseness of the concepts presented	3
6.	The attractiveness of learning activities in electronic modules	3
7.	The accuracy and novelty of the content of teaching materials	3
8.	The accuracy of the presentation of images and videos in the electronic module	3
9.	Adequate summary of material content	3
10.	Evaluation of measuring the ability of students according to teaching material	3
	Acquisition of the total number of validation scores by lecturers ($\sum x$)	30
	The maximum number of scores obtained ($\sum x\,i$)	30
	Percentage of product feasibility $\frac{\sum x}{\sum xi}$ **X 100%**	**100%**

Assessment by media experts occurred twice. Stage 1 validation obtained a result of 93.33%, which means that the electronic module can be used with minor revisions. The revision suggestion is to provide contextual examples that are close to students' daily lives in order to deepen students' knowledge. Stage 2 validation obtained a result of 100%, which means that the electronic module can be used without revision. It can be seen in Table 2:

Table 2. Media Expert Assessment Results

No	Indicator Scoring	Score	
		Stage 1	Stage 2
1.	Suitability of the electronic module with the character of students	3	3
2.	Ease of use of electronic modules	3	3
3.	Practicality of using electronic modules	3	3
4.	The ability of the electronic module to attract students' attention to participate in learning	3	3
5.	Encourage learners' curiosity	2	3
	Acquisition of the total number of validation scores by lecturers ($\sum x$)	14	15
	The maximum number of scores obtained ($\sum x\,i$)	15	15
	Percentage of product feasibility $\frac{\sum x}{\sum xi}$ **X 100%**	**93,33%**	**100%**

Assessment by design experts occurred twice. Stage 1 validation obtained a result of 83.33%, which means that the electronic module can be used with minor revisions. The revision suggestions were to change the front cover image, adjust the size and colour of the text, add reference sources, and add electronic module features. Stage 2 validation obtained a result of 100%, which means that the electronic module can be used without revision. It can be seen in Table 3:

Table 3. Design Expert Assessment Results

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No	Indicator Scoring	Score	
		Stage 1	Stage 2
1.	Electronic module cover design	2	3
2.	The suitability of the electronic module content arrangement with the module Table of Contents	3	3
3.	Appropriateness of text, image, and background colour selection	2	3
4.	Accuracy of font selection	3	3
5.	Appropriateness of using space between lines	2	3
6.	Layout of the electronic module display	2	3
7.	Selection and placement of interactive buttons	3	3
8.	The accuracy of the presentation of images and videos in the electronic module	3	3
	Acquisition of the total number of validation scores by lecturers ($\sum x$)	20	24
	The maximum number of scores obtained ($\sum x\, i$)	24	24
	Percentage of product feasibility $\frac{\sum x}{\sum xi}$ **X 100%**	**83,33%**	**100%**

Assessment by linguists occurred twice. Stage 1 validation obtained a result of 80%, which means that the electronic module can be used with minor revisions. The revision suggestions are improvements in title writing, the use of effective sentences and proper punctuation, tidying up the way of writing, changing page titles, adding reference sources and adding About the Author pages. Stage 2 validation obtained a result of 86.67%, which means that the electronic module can be used with minor revisions.can be seen in Table 4:

Table 4. Design Expert Assessment Results

Design Expert Assessment Results

No	Indicator Scoring	Score		
			Stage 1	Stage 2
1.	Accuracy of sentence structure		2	2
2.	Sentence effectiveness		2	2
3.	Linguistic aspects of electronic modules in accordance with KBBI V		2	3
4.	Use of language that is easy to understand		3	3
5.	Accuracy of the use of terms		3	3
	Acquisition of the total number of validation scores by lecturers ($\sum x$)		12	13
	The maximum number of scores obtained ($\sum x\, i$)		15	15
	Percentage of product feasibility $\frac{\sum x}{\sum xi}$ **X 100%**		**80%**	**86,67%**

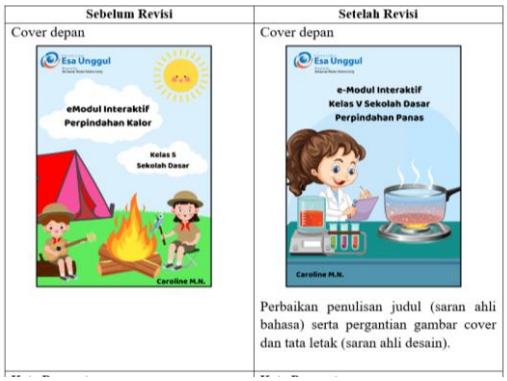

Figure 4: Example of one of the design revision steps

Product Use Stage (Implementation)

The fourth stage is the product use stage (Implementation). This stage is the stage of using the product (Sugiyono, 2019) where researchers apply the developed product in a real classroom situation. (Aminah, 2018).

The product use stage occurred twice, namely small group trials and field trials. The small group trial involved one teacher teaching thematic material and nine students with three different ability levels. The trial results were 91.67%, meaning that the electronic module can be used with minor revisions. It can be seen in table 5:

Table 5. Small Group Trial Results

No	Indicator Scoring	Frequency of Answer Options	Total Score	Persentase (%)

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		B (3)	C (2)	K(1)		
1.	Attractiveness of the electronic module display	8	2	0	28	93.33
2.	Colour combination in the electronic module	6	4	0	26	86,67
3.	The appearance of the electronic module is able to motivate learning	7	3	0	27	90,00
4.	The appearance of the electronic module is not boring	8	2	0	28	93,33
5.	The font used is easy to read	7	3	0	27	90,00
6.	Good display of videos, images, and learning materials	9	0	1	28	93,33
7.	Presentation of material is easy to understand	7	3	0	27	90,00
8.	The presence of electronic modules makes it easier for teachers and students in learning activities	8	2	0	28	93,33
9.	The instructions for using the electronic module are clear	9	1	0	29	96,67
10.	Ease of use of electronic modules	7	3	0	27	90,00
	Avarage					**91,67**

The field trial involved one class at the fifth grade level and the teacher who taught the thematic material. Based on the results of the field trial, the tested electronic module obtained a result of 86.83%, which means that the electronic module can be used with minor revisions. It can be seen in table 6:

Table 6: Field Trial Results

No	Indicator Scoring	Frequency of Answer Options			Total Score	Persentase (%)
		B (3)	C (2)	K (1)		
1.	Attractiveness of the electronic module display	15	5	1	56	88,89
2.	Colour combination in the electronic module	16	5	0	58	92,06
3.	The appearance of the electronic module is able to motivate learning	12	7	2	52	82,54
4.	The appearance of the electronic module is not boring	14	7	0	56	88,89
5.	The font used is easy to read	9	11	1	50	79,37
6.	Good display of videos, images, and learning materials	13	8	0	55	87,30
7.	Presentation of material is easy to understand	13	8	0	55	87,30
8.	The presence of electronic modules makes it easier for teachers and students in learning activities	16	5	0	58	92,06
9.	The instructions for using the electronic module are clear	9	11	1	50	79,37
10.	Ease of use of electronic modules	15	6	0	57	90,48
	Rata-rata					**86,83**

Evaluation Stage

The evaluation stage is useful for assessing the suitability of product specifications (Sugiyono, 2019) and improve the electronic module product after receiving feedback (Kurnia et al., 2019) from thematic material teachers and grade V students. Can be seen in Figure 5:

Figure 5: Example of some pages of the final model of the interactive electronic module

Researchers compared the results of small group trials and field trials and analysed the results of the comparison. Based on the results of the analysis, it was concluded that the tested electronic module obtained a result of 88.99%, which can be used with minor revisions with the highest indicator, namely the presence of electronic modules makes it easier for teachers and

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students in learning activities. It can be seen in Table 7 and Figure 6:

Table 7. Comparison Results of Trial Stages

No.	Indicator Scoring	Small Group Trial	Field Trial	Average Trial
1.	Attractiveness of the electronic module display	93,33%	88,89%	91,11%
2.	Colour combination in the electronic module	86,67%	92,06%	89,37%
3.	The appearance of the electronic module is able to motivate learning	90,00%	82,54%	86,27%
4.	The appearance of the electronic module is not boring	93,33%	88,89%	91,11%
5.	The font used is easy to read	90,00%	79,37%	84,69%
6.	Good display of videos, images, and learning materials	93,33%	87,30%	90,32%
7.	Presentation of material is easy to understand	90,00%	87,30%	88,65%
8.	The presence of electronic modules makes it easier for teachers and students in learning activities	93,33%	92,06%	92,70%
9.	The instructions for using the electronic module are clear	96,67%	79,37%	88,02%
10.	Ease of use of electronic modules	90,00%	90,48%	90,24%
	Average			**88,99%**

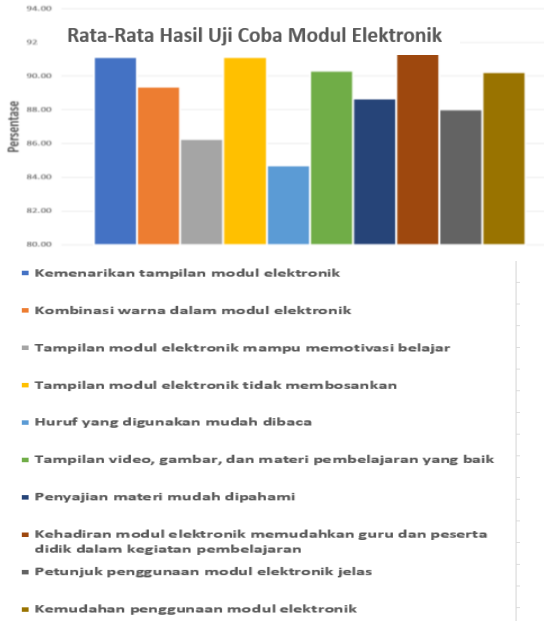

Figure 6: Diagram of Average Electronic Module Trial Results

This is in line with research conducted by (Nugroho et al., 2021) where the rapid advancement of technology has an impact on educational practices. Research conducted by (Novayuliyanti & Syofyan, 2021) argues that the application of science and technology in educational settings benefits and makes certain tasks easier for teachers and students; thus creating an environment that enables students to learn and develop advanced skills. (Syofyan & Amir, 2019).

Conclusion

Based on the research results, it can be concluded that:

1. In research on the development of interactive electronic modules based on Flip PDF Corporate Edition for science learning that focuses on Heat Transfer material in Class V SD, the ADDIE development model is used with five phases, namely (a) analysis, (b) product design, (c) product manufacturing and testing, (d) product use, and (e) evaluation.
2. The interactive electronic module based on Flip PDF Corporate Edition for learning science that focuses on the material of Heat Transfer in Class V SD is a module that is suitable for use in educational activities, because it can be used with minor corrections and facilitates learning for teachers and students.

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