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E-Module Development Assisted By a Professional Flip PDF Application on Virus Material

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Abstract. *This research aims to develop an e-module assisted by the Flip PDF Professional application on the topic of viruses, assess its validity, and assess its practicality. Adopting the development model by Borg & Gall, the study goes through seven stages: potential and problems, data collection, product planning, design validation, design revision, product testing, and product revision. Data were collected through questionnaires given to subject matter experts and media experts to test validity, as well as assessment responses from teachers and students to test the practicality of the e-module. The research findings indicate that the e-module has been developed for use as teaching materials and learning media in high schools. The product's validity from the assessment by subject matter experts is 95.67% and by media experts is 96.06% both categorized as "very valid". Assessment of the product's practicality also yields very positive results, with a percentage of teacher responses at 92.00% and student responses at 89.07%, both categorized as "very practical". This product is highly suitable for use as teaching materials and learning media for biology.*
Key words: *e-module, flip pdf professional, teaching material, viruses*

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Introduction

The technological revolution develops quickly and brings many changes. In the current era of industrial revolution 4.0, the emergence and development of the internet is followed by the latest technology which is changing the way of life and relationships between humans. Dito (2021) stated that we can also see the changes that occurred in the industrial revolution in the teaching sector. The teaching sector is the most important initial basis for the development and progress of the nation's next generation, where teachers are able to innovate and compete with the changes that occur. Therefore, the role of today's teachers is expected to be able to understand the use of technology as a tool or teaching material used by students so as to make the learning process active and enjoyable and is expected to improve the quality and outcomes of student learning (Anggraini et al., 2019). One of the factors that influences student learning outcomes is teaching materials. Teaching materials are a set of learning materials/substances (teaching materials) that are arranged systematically, presenting a complete figure of the competencies that students will master in learning activities. The integrity of teaching materials allows students to study a competency in a coherent, systematic and accumulative manner so that they are able to master all competencies in a complete and integrated manner (Panggabean & Danis, 2020). Modules are a form of teaching material that can be said to be an independent learning medium in which there are instructions for students to carry out the learning process independently. Teaching modules should be able to generate interest in reading, be written and designed based on students' "needs", refer to the competencies that must be achieved, be structured for the instructional process and have a mechanism for collecting feedback from students
(Rahmi, 2017). A module is a systematic teaching material and contains planned learning activities, created to help students master certain learning achievements (Hidayati et al, 2019). The learning process in the teaching world is influenced by

advances in information technology which functions as a tool for presenting learning material. E-modules are an example of the application of information technology in the field of education. According to Suryani & Budi (2022), an electronic module is a sequential and brief presentation of electronic teaching material from the smallest unit of the learning process. The e-module arrangement of images, videos and hyperlinks used is like a conventional printed book so that the teaching and learning process can run without direct discussion between teachers and students (Yahdiyani et al, 2022).

According to Perdana (2019), a module is a printed teaching material that students use as a learning resource. This module plays a role in training students to learn actively and can also support the effectiveness of achieving learning objectives. By using e-modules, students are expected to be able to solve problems in their own way. In preparing teaching materials, innovation is needed to increase students' interest in learning the material and reduce students' dependence on teachers, as well as familiarize students with independent learning (Sari, 2023).

Based on the results of the interview, the teacher stated that there were several biology materials that caused students to be less enthusiastic in the learning process. This is a problem for teachers and teachers also need other, more interesting teaching materials in line with current technological developments. Apart from that, the cause of the lack of enthusiasm of students in learning activities according to research observers is that the textbooks used cannot attract students' reading interest because they only contain a lot of reading about the material, there is a lack of variety in the choice of pictures and there are incomplete pages in the textbooks. used.

The majority of students appear to show little during the learning process. In addition, not all students hold textbooks as a learning resource because the number of textbooks in the library is limited and many are not suitable, so students tend not to focus on learning, get bored, and pay less attention during Biology learning activities. Students need books that are practical but complete and can be taken anywhere, anytime. Presenting complete and interesting material can increase students' enthusiasm for learning. So it can motivate students to read the virus material module. To be practical and interesting, media in the form of e-modules is needed to make learning easier for students. It is hoped that this e-module can also increase student motivation and student understanding in following virus learning material. E-modules are also more interactive, making navigation easier, displaying images, audio, video and animation and can be equipped with formal quizzes/tests allowing immediate automatic feedback.

Methodology of Research

This research model is development research (R&D). The products developed adapt the R&D research method of the Borg & Gall model. Of the ten stages of development, researchers can only reach the seventh stage. The stages start from potential and problems, data collection, product design, design validation, design revision, product testing, and product revision.The following is the Borg & Gall model R&D research procedure (Sugiyono, 2015) that was carried out:

Potential and problems

At this stage, a needs analysis was carried out through interviews and observations of Biology teachers at SMA Muhammadiyah 5 Makassar, namely the availability of infrastructure that supports the learning process, but the school still chose to use printed books that were worn out, some were damaged and also had not developed a learning module using professional pdf flip program. The potential that exists in this school is that internet facilities are adequate and provided by the school to support learning, and there is an LCD projector.

p-ISSN 2621-5527
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Data collection

After the problem is discovered, the next stage is to collect information which is used to create the developed teaching materials. Data collection can be done by means of literature reviews from books, journals, and relevant articles using media creation tools that can be easily accessed using the internet. The data collection carried out includes the selection of products, materials and product designs to be developed. The selection of materials is adjusted to the teaching and learning activities and curriculum at the schools that have been interviewed. The use of e-modules is obtained from literature reviews that have been carried out in making product designs based on the results of the references that have been obtained. The results of all this data collection will be used as the first step for product creation, so that researchers get a professional flip pdf application for creating e-modules.

Product Design

After data collection, the next stage is the planning stage in developing e-modules using the professional flip pdf program on virus material. The following plans for designing the product are shown in Figure 1.

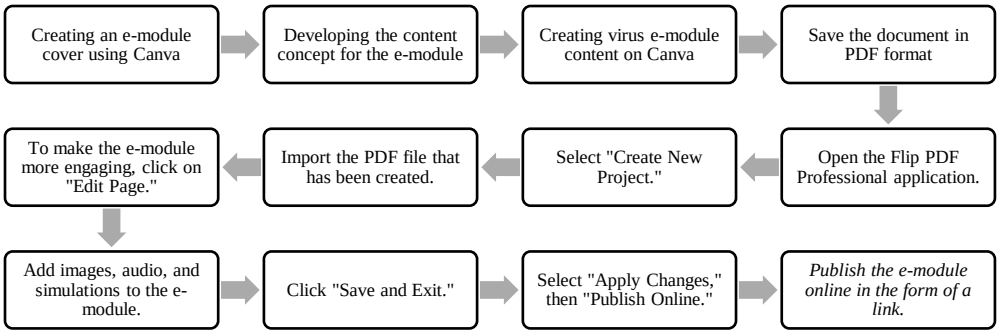

Figure 1. Media Design Chart

The results of the project created can be saved in several formats, namely html, zip, exe, Mac app, mobile version and burn to CD. In this e-module, researchers store it offline and also online in the form of a website link.

Design Validation

Validation is a process or activity to assess whether the e-module product design using the professional flip PDF program has been categorized as an effective e-module and is suitable for use. This validation is said to be rational validation, not field facts. At the validation stage, the initial product design was consulted with a team of experts consisting of material experts and media experts. Material experts analyze and view material that is prepared according to learning outcomes and learning objectives. Meanwhile, media experts analyze and study in terms of media, choosing words according to target characteristics, attractiveness, presentation of text, images and videos, layout, and color choices for components of the composition as a whole.

Design Revision

After the product design is validated by material experts and media experts, the weaknesses and shortcomings of the e-module can be identified using the professional flip pdf

program. These weaknesses are then corrected to produce better, more feasible and effective products.

Product Trial

This product trial was aimed at Biology teachers in class X Science at Muhammadiyah 5 Makassar High School. This educator response test aims to examine the product produced, then the Biology teacher is asked to provide suggestions for improvements regarding the product. Product testing is an important part of development research which is carried out after the product design is complete. Product trials are intended to collect data that can be used as a basis for obtaining the level of practicality of the product produced. Large group trials will be carried out on students in class X Science at Muhammadiyah Muhammadiyah 5 Makassar High School. Students are asked to provide input about the products they have seen using a questionnaire.

Product Revision

At this stage, product improvements are made as a result of field trials. At this stage, product revisions are carried out based on suggestions received during field trials.

The data collection instrument used is a questionnaire, in the form of an expert validation sheet and a practicality questionnaire sheet for teachers and students. The product validation instrument sheet is used to see the validity of the product which will be assessed by material expert validators and media experts, while teacher and student response questionnaire sheets are used to see the practicality of the product that has been developed which will be assessed by teachers and students.

In carrying out data analysis, researchers used qualitative data analysis techniques and quantitative analysis techniques. Quantitative data was obtained from research scores from material expert and media expert validation assessment sheets, as well as practicality questionnaires given to teachers and students of class X Science at SMA Muhammadiyah 5 Makassar. Qualitative data was obtained from input/suggestions provided by material experts and media experts, as well as input/suggestions from teachers and students of class X Science at SMA Muhammadiyah 5 Makassar

The data analysis technique used to analyze the data results for the validity and practicality of the e-module is the percentage analysis technique. The formula used to calculate the questionnaire results is the percentage calculation as follows. The formula used is adapted from Akbar (2017), as follows:

$$Va = \frac{TSa}{TSh} \times 100\%$$

Information :

Va	: Percentage of validation scores
TSa	: Total score obtained
$T.Sh$	: The highest possible total score obtained

Then the percentage results obtained can be grouped into categories of eligibility criteria for validation results and practicality levels in tables 1 and 2 as follows.

p-ISSN 2621-5527
e-ISSN 2621-5535

Table 1. Eligibility Criteria for Validation Results

Percentage	Qualification
80.01%<V≤100%	Very Valid
60.01%<V≤ 80.00%	Fairly Valid
40.01<V≤ 60.00%	Less Valid
20.01<V≤ 40.00%	Invalid
00.00%<V≤ 20.00%	Very Invalid

(Source: Akbar, 2017)

Table 2. Product Practicality Level Criteria

Percentage	Qualification
81≤P<100%	Very Practical
61≤P<80%	Practical
41≤P<60%	Quite Practical
21≤P<40%	Impractical
0≤P<21%	Very Impractical

(Source: Parmin, 2013)

Results of Research

The development of this e-module will be validated by experts or validators in the field, namely material expert validators and media experts. The results of the e-module validity assessment obtained from material experts and media experts are displayed in the following table.

Table 1. Results of E-Module Validity Assessment by Material Experts

Assessment Aspects	**Initial presentation**	**Presentation after revision**
Content Eligibility	62.86%	92.86%
Language	63.33%	96.67%
Presentation	62.50%	97.50%
Average	62.90%	95.67%

Table 2. Results of E-Module Validity Assessment by Media Experts

Assessment Aspects	**Initial presentation**	**Percentage after revision**
Display Screen Design	82.86%	94.29%
Ease of Use	84.00%	96.00%
Consistent	93.33%	100%
Expediency	86.67%	90%
Graphics	100%	100%
Average	89.37	96.06%

The researchers will then use the suggestions from the validator as a reference for improving the e-module product. The stage after validation is product implementation, namely a trial is carried out to determine the level of practicality of the product which can be seen from

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the response questionnaire given to teachers and students. The results of the e-module practicality assessment obtained by teachers and students can be seen in the table below.

Table 3. Results of E-Module Practicality Assessment by Teachers

Rated aspect	Percentage
Content Eligibility	88.00%
Serving	86.67 %
Language	93.33 %
Design	100%
Average	92.00 %

Table 4. Results of E-Module Practicality Assessment by Students

Rated aspect	Percentage
Instructional Media	89.07%
Material	85.93%
Benefit	92.22%
Average	89.07%

Discussion

The development carried out in this research resulted in an e-module using flip pdf professional on virus material for class X SMA/MA which was based on validator assessments and also the responses of educators and students.

1. Potential and Problems

In this research, the results obtained were in the form of an e-module using flip pdf professional on virus material. This research was conducted at SMA Muhammadiyah 5 Makassar in class X Science. This development research was carried out using the Borg and Gall method stages up to stage 7. The research stages are:

a. Results of needs analysis

The research begins with conducting interviews to find out product needs in the field. The interview serves to determine the real conditions of learning media in schools and is followed by a literature study which functions to search for the theory underlying the research and support the basic ideas for product development obtained from the interview results.. Needs analysis was carried out by direct observation of learning activities at SMA Muhammadiyah 5 Makassar to find out the basic problems found in the learning process, especially in biology learning for future e-module development.

The development carried out in this research resulted in an e-module assisted by the professional flip pdf application on virus material for class X. The following summary of the interview results can be seen in table 1.

Table 1. Analysis Interview Results

Question	Answer
In relation to which Biology subject matter has a large weight and still has problems when learning?	Virus Material, Coordination System, and Reproductive System
Do students still often experience misconceptions about this material?	Often, especially in virus material and coordination systems
Is it also difficult for teachers to assess this material?	It is quite difficult, because we cannot yet reveal all the material that students must master
How do teachers overcome time constraints	Provide individual and group assignments

p-ISSN 2621-5527
e-ISSN 2621-5535

during the learning process?	
How is the learning media used in the learning process?	Does not use learning media
How is the use of learning media in this material considered effective and efficient?	Haven't used yet
How does the teacher understand the teaching materials?	Teaching materials that can be used in learning so that they can be systematic
What form of teaching material do you provide to students in the learning process?	Most students' learning resources only use textbooks.
Are the conditions when the learning process using teaching materials runs effectively and efficiently?	Less effective because sometimes students are less motivated
What are the obstacles to teaching when using teaching materials during learning?	Many students are lazy to read because it is not interesting
Suggestions for developing teaching materials in the form of IT-based modules?	The module contains videos/images, materials, and is interactive so as to increase student motivation.

Based on the results of the needs analysis interview, several potentials and problems were found which could become basic ideas for R&D research. The first aspect that was found was that virus material was classified as biology learning material which had a large weight. Teachers still find it difficult to carry out assessments due to limited learning time so that students have difficulty understanding the material and there are still frequent misconceptions about the material. In the second aspect, teachers have not used effective and efficient learning media for students. In the third aspect, it is felt that the use of teaching material sources used has not been optimized properly. The use of teaching materials is still dominated by textbooks, so students need more interesting learning media and teaching materials, namely in the form of audio-visual media that can be accessed independently.

Based on the description of the interview results above, the potential for developing e-modules on virus material was found. The product developed also takes into account the teacher's suggestions during interview activities. These suggestions include:

1) The material that is made into teaching materials and learning media must be concise but concise so that students can make the e-module easy to understand.
2) Learning media must be as attractive as possible, equipped with pictures and videos so that students can easily understand the material
3) Meanwhile, learning media must be equipped with attractive icons related to the material

2. Data collection

a. Technology Analysis

Based on direct observations at SMAN Muhammadiyah 5 Makassar, the author gathered information that this school is equipped with adequate technological facilities, which can support the student learning process. At this school, there is a sufficient number of computer laboratories, as well as adequate internet access. Apart from that, there is WiFi and several LCD projector units available. This will allow students to run e-modules using a laptop if they do not have a smartphone.

b. Curriculum Analysis

The curriculum used at SMAN Muhammadiyah 5 Makassar based on observations is the 2013 curriculum for classes XI and XII and the independent curriculum for class X. The teaching materials used in class Researchers first identify the CP, learning objectives, and the lesson material to be taken, namely vieus. Virus material is found in phase E of class X biology subjects.

p-ISSN 2621-5527
e-ISSN 2621-5535

Table 2. Learning Outcomes and Learning Objectives

Learning Outcomes	Learning objectives
At the end of phase E, students can describe the characteristics of viruses, differentiate the virus replication process, identify the role of viruses, create solutions to the spread of viruses, and describe the role of viruses in biotechnology.	1. Through discussion activities, students are able to identify the characteristics of viruses correctly 2. Through literacy activities, students are able to correctly analyze the role of viruses that are detrimental to humans 3. Through discussion activities, students are able to analyze solutions to the spread of viruses that are detrimental to humans correctly

Based on this table, learning outcomes and learning objectives are used as a reference that will be integrated into the creation of e-modules which will be prepared in accordance with the demands of the independent curriculum.

3. Product Design

The following are the steps in preparing a product design:
Creating an e-module is preceded by determining what material will be included in the e-module in relation to learning outcomes and learning objectives. Learning outcomes and learning objectives are obtained in the independent teaching application. The material concept can be seen in table 3 as follows.

Table 3. Material concept

Learning Outcomes	Learning objectives	Material
At the end of phase E, students can describe the characteristics of viruses, differentiate the virus replication process, identify the role of viruses, create solutions to the spread of viruses, and describe the role of viruses in biotechnology.	1. Through literacy activities and discussions, students are able to identify the characteristics of viruses and correctly differentiate the virus replication process.	• Definition of viruses • Characteristics of viruses • Virus replication process
	2. Through literacy activities, students are able to correctly analyze the role of viruses that are detrimental to humans	• The detrimental role of viruses in humans
	3. Through discussion activities, students are able to analyze solutions to the spread of viruses that are detrimental to humans correctly	• Solutions for dealing with the spread of viruses that are detrimental to humans

Cover making stage. The cover of this e-module was designed in the Canva application and then adjusted to the title of the material the researcher took, namely viruses. The e-module cover page has a combination of white, blue and yellow, and consists of the e-module title, class level, independent curriculum logo, university logo, faculty and study program as well as images relevant to the viral material. The e-module cover can be seen in the following image.

p-ISSN 2621-5527
e-ISSN 2621-5535

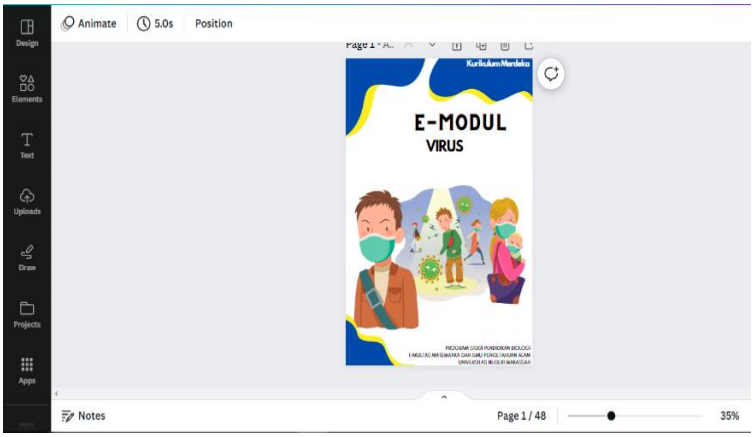

Figure 1.Create the front view of the e-module

After the cover creation is complete. The next stage is typing the material and designing the e-module learning according to the learning outcomes and learning objectives. Provide free space which will later be used to add learning videos. The typing and designing process still in the Canva application can be seen in the following image.

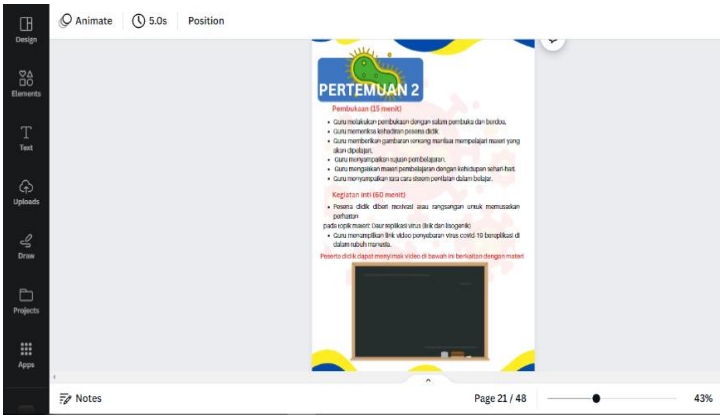

Figure 2. Free space for video

After typing the material, learning plan, instrument and assessment rubric in the Canva application, save the document in PDF format. Search for and determine images and videos that suit the learning objectives. Then, open the flip pdf professional application, select create new project which can be seen in the following image.

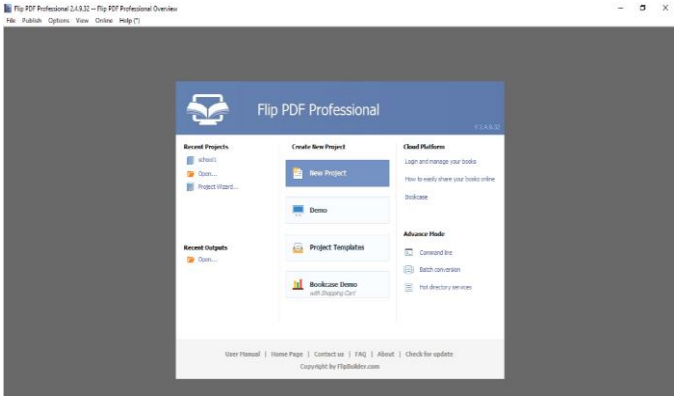

Figure 3. Display with professional pdf flip

The Flip pdf professional application has opened and select create new project and the import pdf (image) window will appear. At this stage, enter the PDF file that has been prepared by selecting "browse" then import now, the initial project display will appear in the Flip PDF Professional application and can be seen in the following image.

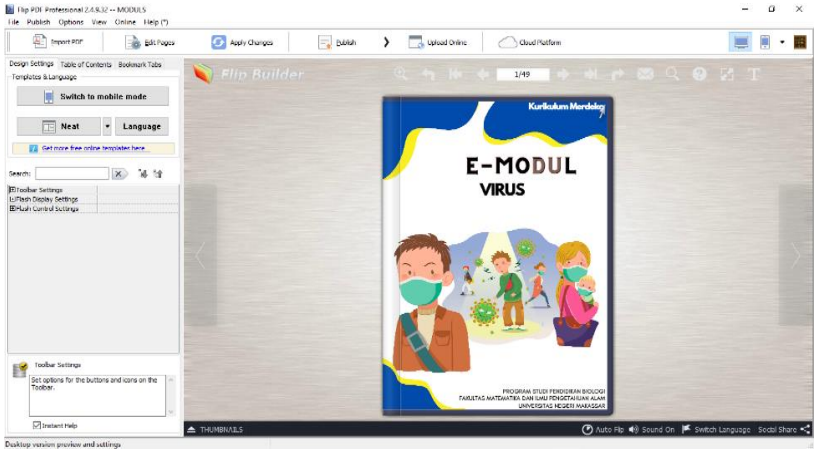

Figure 4. The initial display that has been imported

In the initial project display there is an edit page window, select it then add a learning video, question form link, in the empty space provided which can be seen in Figure 5 below.

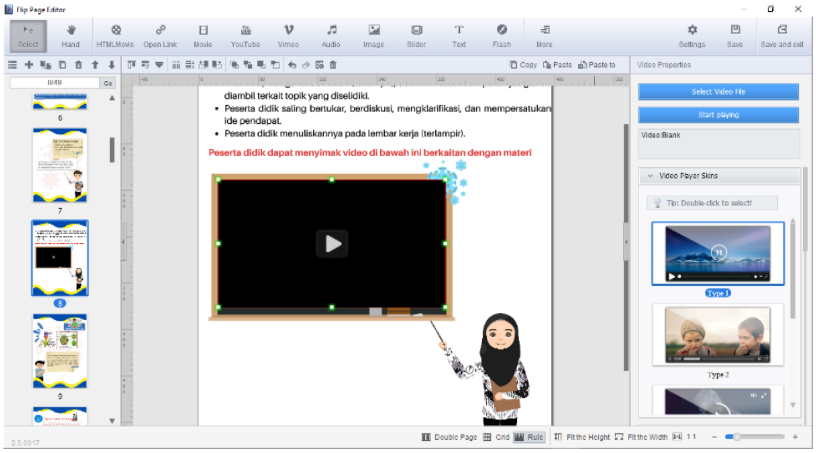

Figure 5. Page editing window

After the editing process is complete, select save and exit. Select a background in the templates menu to make the appearance more attractive. Then select apply change after that select publish online.

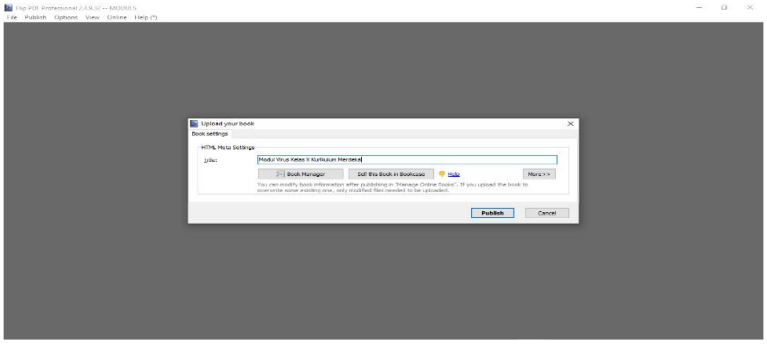

Figure 6. Display output options

p-ISSN 2621-5527
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4. Design Validation

The next stage after developing the e-module is product validation to find out how the validator assesses the e-module that has been created. This validation was carried out by 2 experts who are experienced in their fields, namely 1 media expert and 1 material expert.

a. Material Expert Validation

Assessment by material expert validators on e-module development using flip pdf professional on virus material can be seen in table 3

Table 3. Percentage of material expert validation results

Assessment Aspects	Presentation before revision	Presentation after revision
Content Eligibility	62.86%	92.86%
Language	63.33%	96.67%
Presentation	62.50%	97.50%
Average	62.90%	95.67%

Material expert validation was carried out by 1 expert in the field of biology. The validation carried out includes 3 aspects of assessment, namely aspects of appropriateness of content, language and presentation. The presentation aspect gets a higher percentage than other aspects because it contains the suitability of learning material with learning outcomes (CP), clarity of learning objectives, suitability of learning activities with students' learning needs, useful material to increase knowledge insight, suitability of picture illustrations with material, suitability of videos learning with learning materials, suitability of learning video narratives, and suitability of assignments with learning materials. The validation results obtained an average percentage of all aspects with an initial assessment of 62.90% with quite valid criteria. The suggestion for improvement given by the material expert is to separate the learning plan that will be given to the teacher from the material/reading material given to students so that it is hoped that both parties will not feel confused when reading the e-module. The assessment instruments and rubrics are uploaded to Google Docs (document) so that teachers can fill in directly or download the file which will make it easier for teachers to give assessments. Added instructions for use in working on LKPD so that students can be more focused and easier to understand the process of working on LKPD. Add image captions below the example images, and add the learning video sources used. After revision, the average assessment percentage increased to 95.67% with the assessment category being very valid. So the e-module using flip pdf professional is said to be very valid to use and can be used for testing.

b. Media Expert Validation

The assessment carried out by media expert validators on e-module development using flip pdf professional on virus material can be seen in table 4.

Table 4. Percentage of validation results from media experts

Assessment Aspects	Initial presentation	Presentation after revision
Display Screen Design	82.86%	94.29%
Ease of Use	84.00%	96.00%
Consistent	93.33%	100%
Expediency	86.67%	90%
Graphics	100%	100%
Average	89.37	96.06%

E-Module Development Assisted By a Professional Flip PDF Application on Virus Material
(page 9-26)
p-ISSN 2621-5527
e-ISSN 2621-5535

Media expert validation was carried out by 1 expert in the media field. The validation carried out includes 5 aspects of assessment, namely aspects of screen design appearance, aspects of ease of use, consistency, usefulness and graphics. The aspects of consistency and graphics get a higher percentage than other aspects because in terms of design creativity, the level of the main title and subtitles is clear and proportional and able to reveal the meaning of the object, the use of color is appropriate and not excessive, the use of words, terms, and the sentences in the learning material are consistent, the use of shapes, letters, layout layout is consistent. Based on media expert validation data, the average initial assessment percentage was 89.37%. The suggestions and improvements given by the media expert validator were checking the consistency of the e-module layout, adding pictures of more diverse types of vaccines, and adding several other sources to the teacher and student reading material. After revision, the average assessment percentage increased to 96.06%. with a very valid assessment category. This shows that e-modules developed using flip pdf professional are said to be very valid learning media and teaching materials for use in the learning process.

5. Product Trial

After the product was validated and revised and was declared very good by the validator, the product in the form of an e-module using professional pdf flip on virus material was tested at a school, namely SMA Muhammadiyah 5 Makassar. The trial was carried out in several stages, namely small group trials, large group trials on class X Science students.

a. Group trials

Student response questionnaire data obtained from group trials at SMA Muhammadiyah 5 Makassar is displayed in table 5 below.

Table 5. Results of large group trials in Muhammadiyah High School 5 Makassar

Rated aspect	Percentage
Instructional Media	89.07%
Material	85.93%
Benefit	92.22%
Average	89.07%

The group trial stage was carried out at SMA Muhammadiyah 5 Makassar with a total of 30 students. The average result of the large group test percentage of students on e-modules using flip pdf professional was 89.07% with very practical criteria. From the results of group trials, researchers analyzed that the benefits obtained were higher than other aspects. Students feel that this e-module, assisted by the professional flip PDF application, can be used easily because with the help of a laptop/computer/cellphone, this e-module can be accessed online and offline. Apart from containing material, it also contains images, audio and video which are helpful and interesting in understanding the material. Students also feel motivated in learning.

b. Trial Results for Educators at SMA Muhammadiyah 5 Makassar

Educator response questionnaire data obtained from the educator trials at SMA Muhammadiyah 5 Makassar is displayed in table 6 below:

Table 6. Results of educator trials in Muhammadiyah High School 5 Makassar

Rated aspect	Percentage
Content Eligibility	88.00%
Serving	86.67%
Language	93.33%
Design	100%
Average	92.00%

p-ISSN 2621-5527
e-ISSN 2621-5535

Assessment of the response of biology subject educators at SMA Muhammadiyah 5 Makassar. There are 4 aspects of assessment, namely the appropriateness aspect of the content, presentation aspect, language aspect, and design aspect. Based on data from the results of the assessment of educators' responses carried out by 1 teacher, a percentage of 92.00% was obtained with very practical assessment criteria. These results show that the e-module using flip pdf professional can be said to be very practical and can be used in the learning process.

6. Final Product

The final product of e-module development research using professional pdf flip on virus material has no further suggestions or improvements so that the e-module product has adequate quality and is very good for use in the biology learning process. The following is a display of the e-module using professional pdf flip on virus material. The final appearance of the e-module can be seen at picture following.

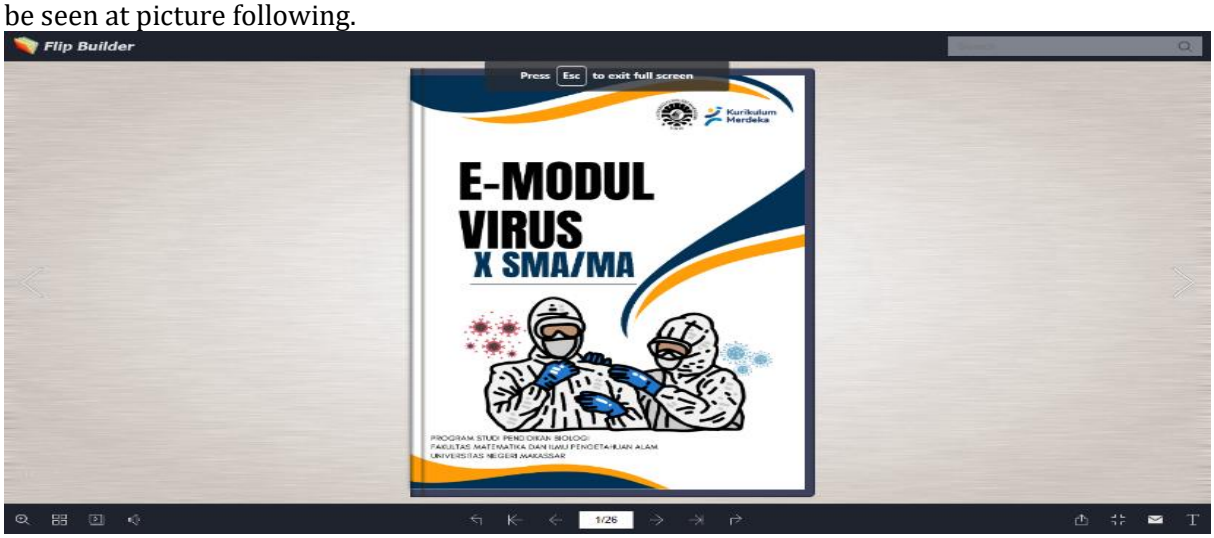

Figure 1. Front view*e-module*

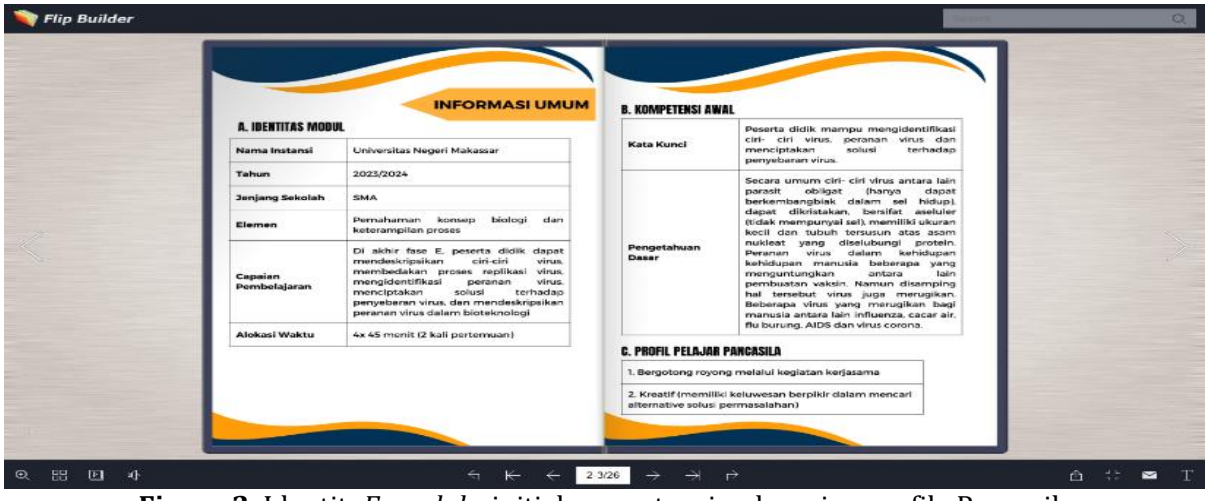

Figure 2. Identity*E-module*, initial competencies, learning profile Pancasila

E-Module Development Assisted By a Professional Flip PDF Application on Virus Material
(page 9-26)

p-ISSN 2621-5527
e-ISSN 2621-5535

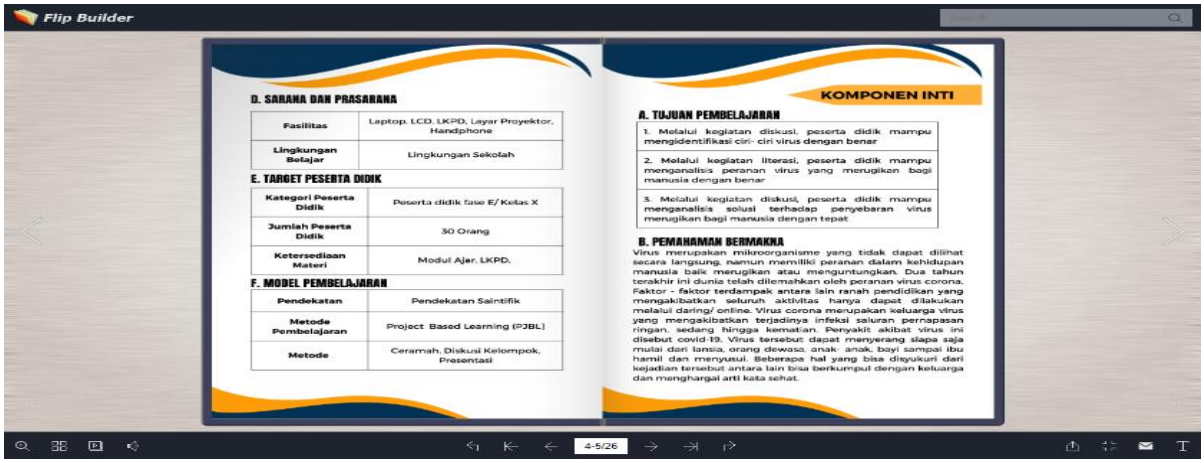

Figure 3. Facilities and infrastructure, target students, learning models, learning objectives, meaningful understanding

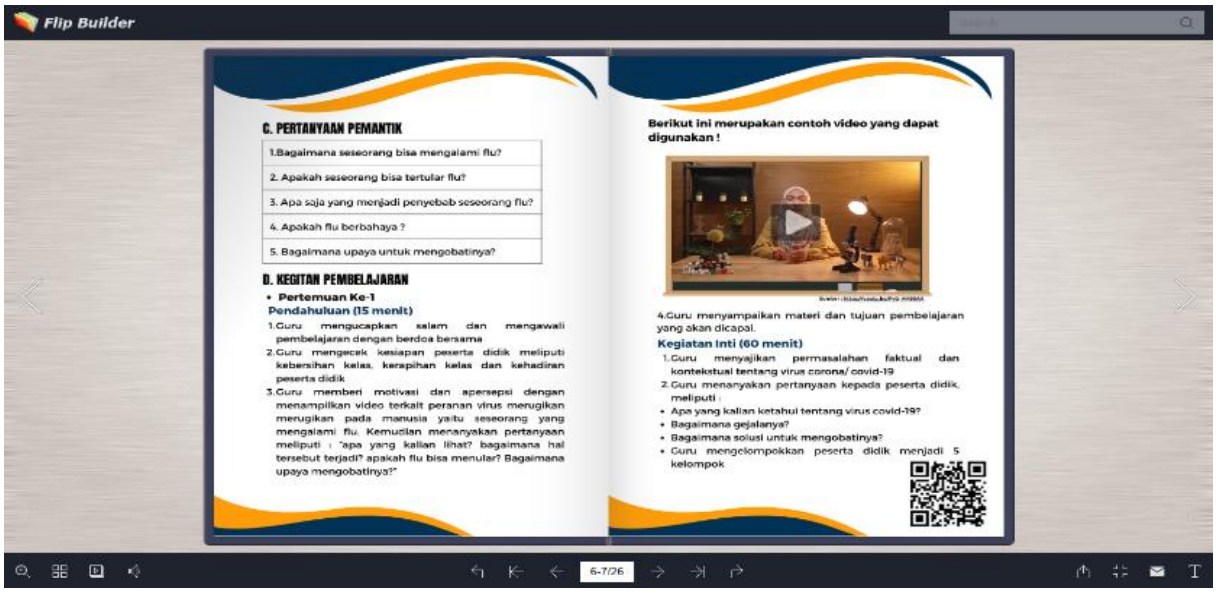

Figure 4. Sparking questions, learning activities, related videos with learning

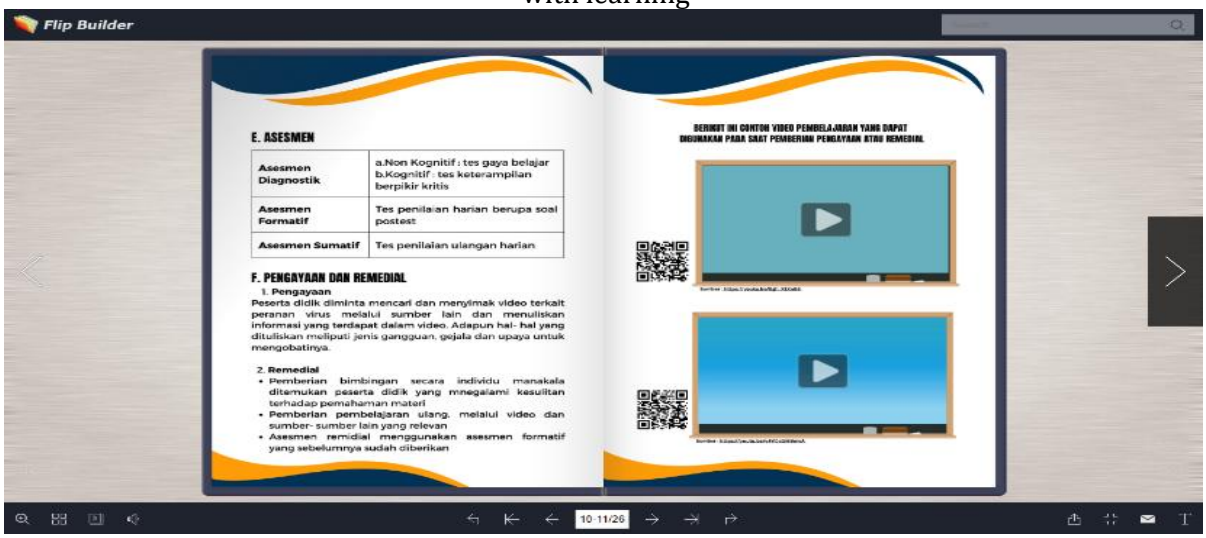

Figure 5. assessment,penrichmentand remedial

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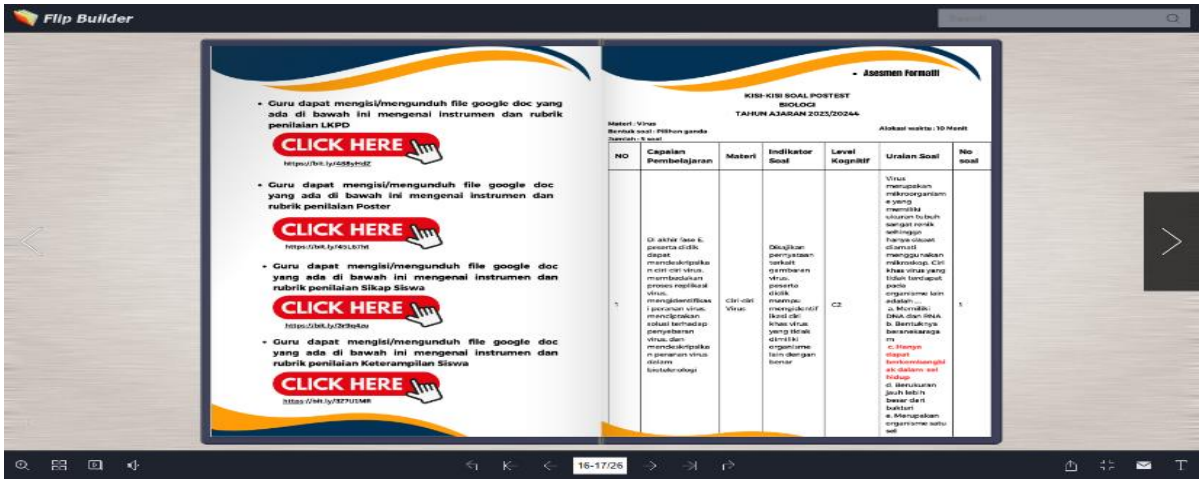

Figure 6. Assessment instruments and rubrics

Figure 7. Final competency test

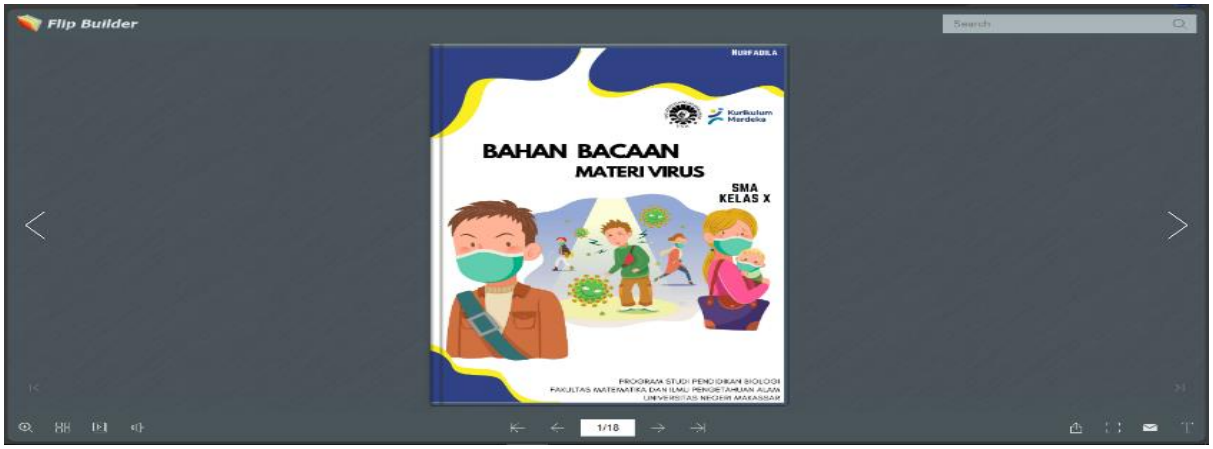

Figure 8. teacher and student reading materials

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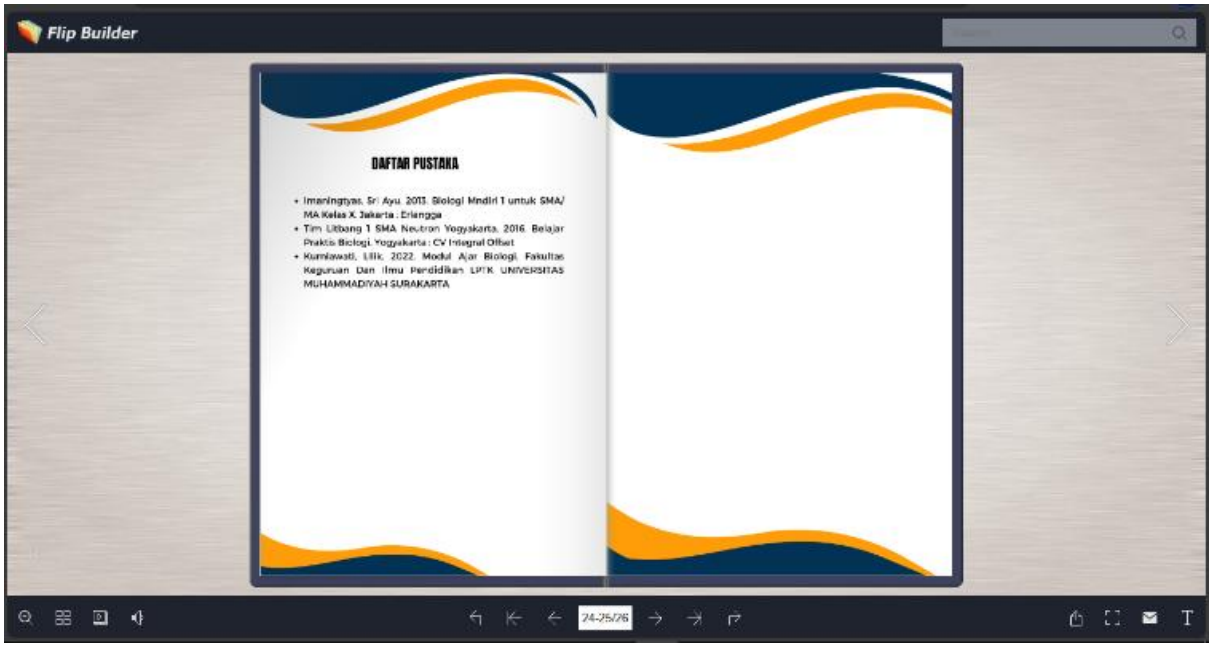

Figure 8.Bibliography

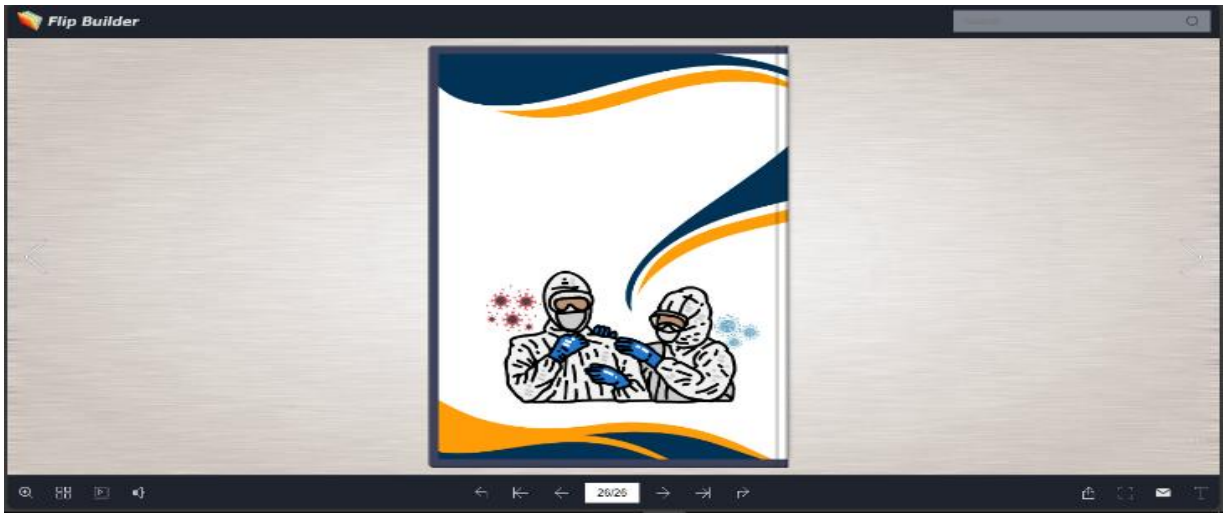

Figure 9. Rear view *e-module*

The e-module product developed is declared to be very valid and very practical as a learning medium and biology teaching material for educators and students at the SMA/MA level. Previous research also concluded that interactive electronic books (BUDIN) using the professional flip PDF application received very good responses from students and were suitable to be used to train students' high-level thinking skills (Diah & Kustijono, 2017). In the e-module developed using professional flip pdf on virus material, there are advantages, namely this e-module can help students understand virus material in biology learning. The e-module developed is not boring because it is in the form of audiovisual media containing images, audio and videos that can increase students' interest, apply technology so that learning can be accessed using laptops, computers and cellphones, e-modules can be accessed offline/online on all laptops, computers and cellphones and can be used independently by students.

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Conclusions

Based on the research conducted, the following conclusions can be drawn:

1. The e-module product using professional pdf flip on virus material has been developed with e-module development stages through 7 stages, namely potential and problems, data collection, product planning, design validation, design revision, product testing and finally product revision.
2. The results of product validation by material and media experts obtained an average assessment score of material experts of 95.67% and media experts of 96.06% with the interpretation criteria being very valid.
3. The results of product practicality by testing it on students were 90.37% for small group trials and 89.07% for large group trials with the interpretation criteria being very practical.

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