At-Taqaddum
http://journal.walisongo.ac.id/index.php/attaqaddum/index
DOI: http://dx.doi.org/10.21580/at.v15i1.13674

Learning Mathematical Logic and Sets Using E-Learning

Syariful Fahmi*, Soffi Widyanesti Priwantoro

Universitas Ahmad Dahlan, Jln Ringroad Selatan, Tamanan, Bantul, Yogyakarta, Indonesia

*Correspondence email: syariful.fahmi@pmat.uad.ac.id

ISSN: 1979-4703 (p)
ISSN: 2527-9726 (e)

Article history:
Received: 29 Nov 2022
Accepted: 10 May 2023
Published: 25 July 2023

Keywords:
logic learning, video, project-based

ABSTRACT

Video is a learning medium that is simple to integrate into a variety of activities, both online and offline. As a result, video development, including studying mathematical logic and set material, is essential. This research aims to develop project-based educational videos on mathematical logic and mathematics material. This research is development research using the Richey & Klein (DPE) development model. There are three stages of development: design, production, and evaluation. This educational video was implemented on 25 students in the third semester of the Mathematics Education Study Program (FKIP UAD). The results of the material expert assessment showed a score of 4.23 (good category) and the media expert assessment scored 4.55 (very good category). Besides that, the student's response during implementation got a score of 3.9 (good category).

Introduction

Video is a learning medium that is simple to integrate into a variety of activities, both online and offline, especially during the COVID-19 pandemic. Videos are needed to help students understand the learning activities. Research shows that implementing educational videos is considered adequate in learning activities (Hadi, 2017). Saman and Tiro (2019) state that using videos in mathematics learning can increase students' motivation and achievement. Therefore, videos are essential to use as a mathematics learning medium.

Moreover, educational videos are also seen as an appropriate medium for learning activities in the era of the Industrial Revolution 4.0 (Putry et al, 2020). Educational videos have several benefits. Students can see some events that cannot be seen directly because of danger or past events. They can play back the videos as needed. This learning also can increase their interest and motivation (Yudianto, 2017). Therefore, educational videos can provide students access to more insightful knowledge that may be difficult to reach directly. Sudjana & Rivai (1992) previously emphasized that videos provide benefits: (1) students can increase their motivation, (2) the message will be more precise so that students can understand and master the materials easily based on the learning objectives.

In this research, the development of educational videos was combined with project-based learning (PjBL). PjBL allows students to learn something by carrying out activities and

applying ideas through activities related to the real world like a professional (Krajcik & Blumenfeld, 2006). Moreover, it allows teachers to manage learning in the classroom by involving projects containing complex tasks based on a problem as an initial step in collecting and integrating new knowledge in line with their experiences in daily activities (Widyantini, 2014). On the other hand, the Mathematical Logic and Sets courses contain very closely related content to daily life. Therefore, PjBL is very suitable for integrating into learning mathematical logic and sets using video as learning media.

Previously, some researchers have developed project-based educational videos in mathematical logic and sets courses. Hasyim (2018) carried out project-based video development on linear equations material. Then, Vahini (2021) also developed project-based videos to develop students' reasoning abilities. Reasoning is closely related to mathematical logic but not for mathematical logic and sets. Situmorang (2015) specifically researched mathematical logic and sets courses, but it was just on invasion of learning. Therefore, this research needs to focus on developing project-based videos in mathematical logic and set courses.

Research Methods

This study used developmental research design to develop project-based videos as learning media on mathematical logic and sets. This study uses the Richey & Klein development model (DPE Model) which consists of three development steps: design, production, and evaluation. At the design stage, we carried out need analysis of the material and curriculum. Besides that, we also developed the instruments of product assessment and product design. At the production stage, the product design that has been created is developed into a video. Then, the editing process is carried out to implement the product realistically. The final stage is evaluation which validators, media experts, and material experts assess the quality of the product. In the end, the product is implemented in classroom learning activities.

The implementation was conducted in the Mathematical Logic class and the third-semester Student Association of Mathematics Education Study Program at Universitas Ahmad Dahlan. 25 students took part in the lecture activities and responded to the products. Figure 1 shows a fishbone diagram of the research stages carried out.

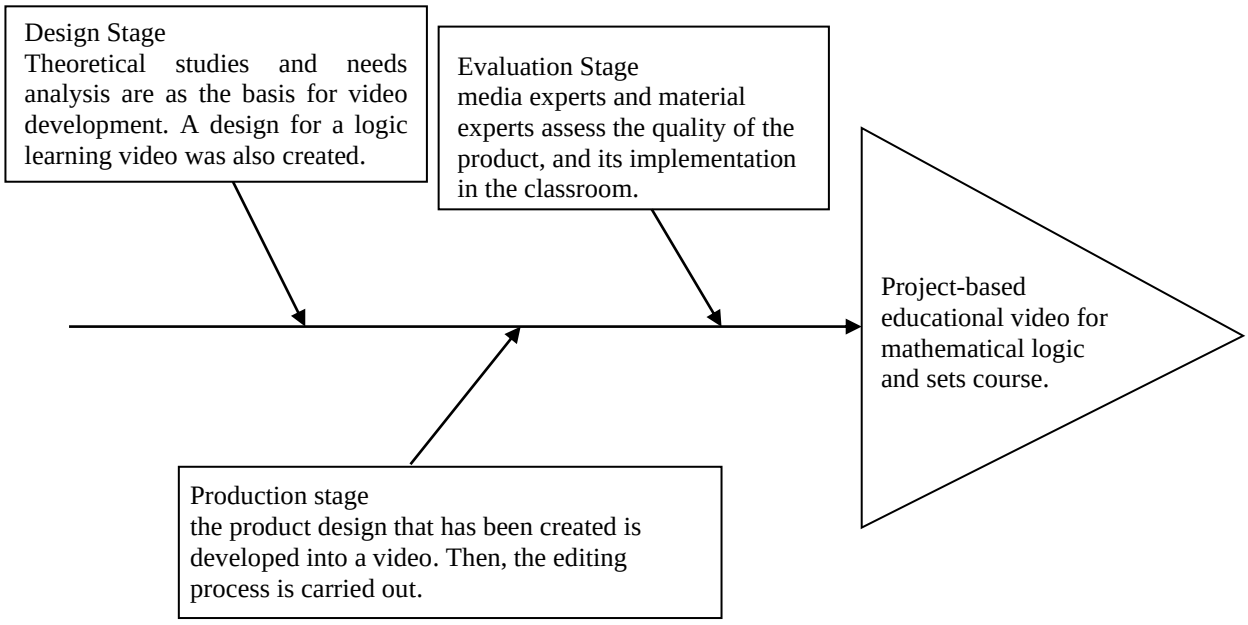


Figure 1. Fishbone diagram of research stages

Results and Discussion

Educational videos on mathematical logic and sets material are developed by using the DPE (Design, Production, and Evaluation) development model. The activities carried out in each stage are explained as follows:

1. Design
   Some activities were carried out at this stage including needs analysis in the form of curriculum and material. Based on the curriculum, mathematical logic and sets course has several achievements as shown in Table 1.

Table 1. Achievements in Mathematical Logic and Sets Course

CPMK-1	Mastering mathematical pedagogical-didactic concepts to carry out primary and secondary education learning oriented toward life skills.
CPMK-2	Demonstrate an attitude of hard work, responsibility, and the ability to work together in attending face-to-face lectures, teaching practice, and finishing lecture assignments (KU-002, KU-007).
CPMK-3	Mastering mathematical theoretical concepts including mathematical logic, discrete mathematics, algebra, analysis, geometry, probability theory, statistics, principles of mathematical modeling, linear programming, differential equations, and numerical methods that support mathematics learning in primary and secondary education, as well as for further studies.
CPMK-4	Mastering the principles and techniques of planning, implementing, and evaluating in mathematics learning.
CPMK-5	Mastering factual knowledge about the functions and benefits of technology, especially information and communication technology, which is related to mathematics learning.

From this Course Learning Outcomes (CPMK), learning materials and content related to mathematical logic and sets are compiled, as shown in Table 2. These materials will be developed into e-learning on mathematical logic and sets for each meeting.

Table 2. List of materials at each meeting of the Mathematical Logic and Sets Course

Meeting	Materials
1	Statement or proposition
2	Compound Statements and Their Truth Tables including Negation, Conjunction, Disjunction, Implication, and Bi-implication
3	Calculus Statement, including tautology and contradiction, truth value functions
4	Quantification and Predicate Logic with learning materials: Logical Equivalence, Negation of Statements with Quantification, Translating Sentences into Logical Expressions, and System Specifications with Quantification.

5	Inconsistency of Statements
6	Proof in Mathematics: Direct Proof and Indirect Proof *(Reductio Ad Absurdum)*
7	Sets Concept
8	Mid-term Test
9	Relation between Logic and Sets and Operations on Sets
10	Understanding Relations
11	Inverse Relations
12	The types of relations are symmetric relations, reflexive relations, transitive relations, and equivalent relations.
13	Function Concept
14	Types of Functions
15	Function Composition
16	Final Test

In general, the concept map in the Mathematical Logic and Sets course developed in this research is shown in Figure 2. At this stage, the instruments of material and media expert assessment and student response questionnaires were also made and developed based on indicators in the theoretical study. To have a clear design on the learning needs and technical capabilities of the organization and students, the form of e-learning products evaluation must consider some aspects as follows:

1. Related content aspects
   a. The products produced are suitable to the community user target.
   b. The learning objectives are clear, and the content is exciting and interactive.
   c. Well-structured content.
   d. The language used is easy to understand and provides links to additional sources of information.

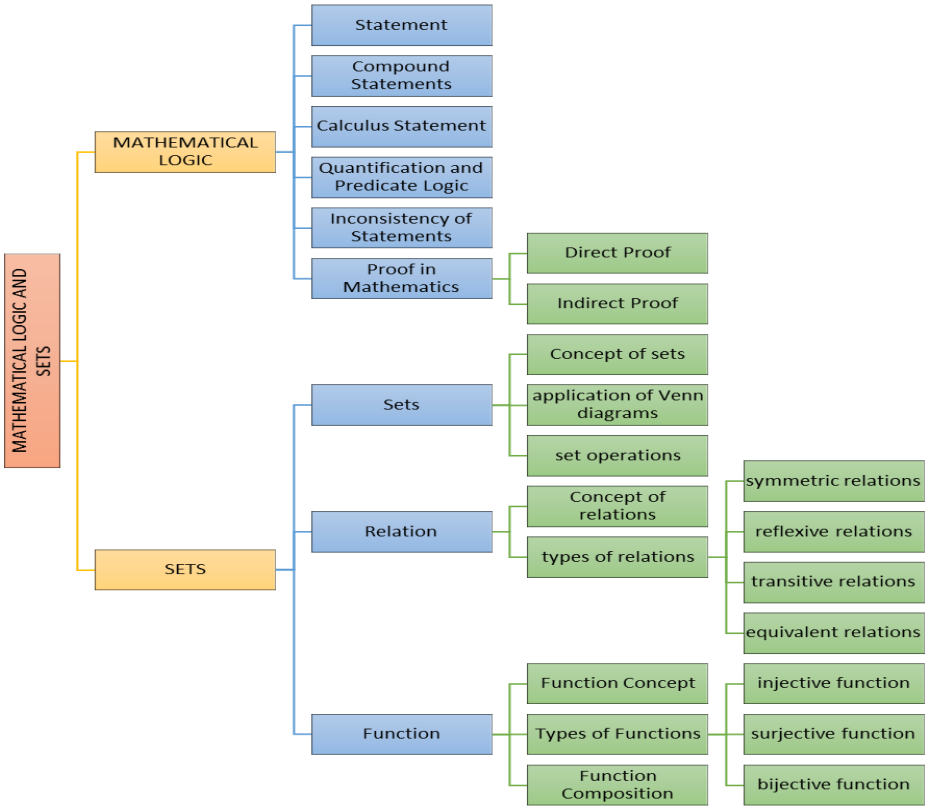


Figure 2. Concept Map of Mathematical Logic and Sets Course

e. Reference
f. Content related to other scientific disciplines. (references for models, theory, and practice)
g. There are exercises related to the content, and there are clear instructions.
h. Assessment including self-assessment

2. Communication and collaboration aspects
   a. Possibility to communicate simultaneously (chatting).
   b. Possibility to communicate asynchronously (email, forum, SMS, etc.)
   c. Determining time limits for asynchronous communications
   d. Possibility to form groups.
   e. Possibility to upload or download documents.
   f. The product includes a calendar (note function).
   g. Having the training to make good communication.

3. Didactical aspects
   a. Respect different levels of expertise.
   b. Having an interactive form of learning.
   c. having supporting and explanation facilities.
   d. As a means to understand, apply, or develop knowledge.
   e. Does it allow teacher support or a FAQ?
   f. Does it include case studies?

4. Use and usability aspect
   a. Ease of use
   b. It's easy for staff to add, delete, and upgrade the content.
   c. Having a clear presentation package and professional appearance. Graphics, visual style, sound, and animation choices should increase learning points.
   d. Is the design attractive?
   e. Navigation and orientation should be easy.
   f. Can users find information quickly? The index contains keywords or topics.

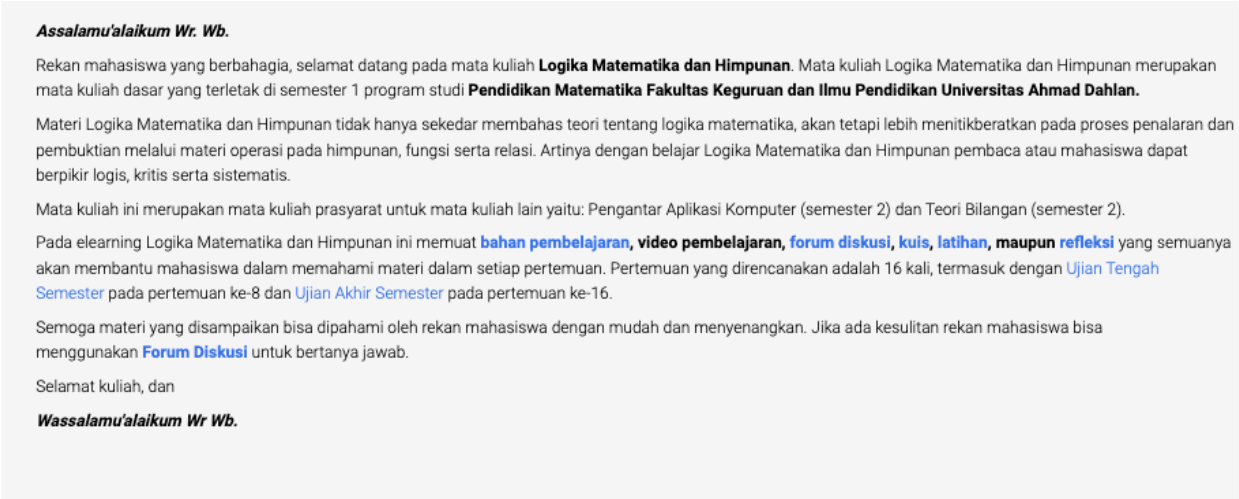
2. PRODUCTION

Some activities are carried out at the production stage including e-learning development based on material prepared. Overall, there were 16 meetings for the implementation. Material, practice, and assessment items are prepared in the Semester Lesson Plan (RPS). Students must do some tasks, depending on the competencies that will be taught. Assignments include PowerPoint presentations, videos, quizzes, questions, and so on. Online teaching materials are teaching materials used in online learning using the Learning Management Systems (LMS) of UAD. Supporting materials in the form of quiz models, texts, simulations, animations, films, audio-visual, forums, assignments, multimedia, and chat can be added to enrich the material that has been prepared.

Lectures are carried out through an online learning model (e-learning), in a Moodle-based learning management system (LMS) (https://elearning.uad.ac.id/). The e-learning website contains menus that are adequate to support online learning. The e-learning home page display was created using Canva as the design. Here are some of the looks of the display. Figure 3 shows the home display of e-learning.

Figure 3. E-learning homepage display

This home page consists of:
1. Cover e-learning,
2. Greetings for students, learning outcomes, and references used to support further learning on the materials. E-learning provides learning resources that can be accessed directly through educational videos, reference books, and assessments. Here is the display:



Assalamu'alaikum Wr. Wb.

Rekan mahasiswa yang berbahagia, selamat datang pada mata kuliah **Logika Matematika dan Himpunan**. Mata kuliah Logika Matematika dan Himpunan merupakan mata kuliah dasar yang terletak di semester 1 program studi **Pendidikan Matematika Fakultas Keguruan dan Ilmu Pendidikan Universitas Ahmad Dahlan.**

Materi Logika Matematika dan Himpunan tidak hanya sekedar membahas teori tentang logika matematika, akan tetapi lebih menitikberatkan pada proses penalaran dan pembuktian melalui materi operasi pada himpunan, fungsi serta relasi. Artinya dengan belajar Logika Matematika dan Himpunan pembaca atau mahasiswa dapat berpikir logis, kritis serta sistematis.

Mata kuliah ini merupakan mata kuliah prasyarat untuk mata kuliah lain yaitu: Pengantar Aplikasi Komputer (semester 2) dan Teori Bilangan (semester 2).

Pada elearning Logika Matematika dan Himpunan ini memuat **bahan pembelajaran, video pembelajaran, forum diskusi, kuis, latihan, maupun refleksi** yang semuanya akan membantu mahasiswa dalam memahami materi dalam setiap pertemuan. Pertemuan yang direncanakan adalah 16 kali, termasuk dengan Ujian Tengah Semester pada pertemuan ke-8 dan Ujian Akhir Semester pada pertemuan ke-16.

Semoga materi yang disampaikan bisa dipahami oleh rekan mahasiswa dengan mudah dan menyenangkan. Jika ada kesulitan rekan mahasiswa bisa menggunakan **Forum Diskusi** untuk bertanya jawab.

Selamat kuliah, dan

Wassalamu'alaikum Wr Wb.

Figure 4. Display of the e-learning greeting page

3. Course description. Here is the display:

Deskripsi Mata Kuliah Logika Matematika dan Himpunan

1. Relevansi Mata Kuliah

Mata kuliah Logika Matematika dan Himpunan merupakan mata kuliah dasar yang terletak di semester 1 program studi Pendidikan Matematika Fakultas Keguruan dan Ilmu Pendidikan Universitas Ahmad Dahlan.

Materi Logika Matematika dan Himpunan tidak hanya sekedar membahas teori tentang logika matematika, akan tetapi lebih menitikberatkan pada proses penalaran dan pembuktian melalui materi operasi pada himpunan, fungsi serta relasi. Artinya dengan belajar Logika Matematika dan Himpunan pembaca atau mahasiswa dapat berpikir logis, kritis serta sistematis.

Mata kuliah ini merupakan mata kuliah prasyarat untuk mata kuliah lain yaitu: Pengantar Aplikasi Komputer (semester 2) dan Teori Bilangan (semester 2)

2. Kemanfaatan Mata Kuliah

a. Mata kuliah ini tidak menekankan pada penggunaan atau penguasaan rumus-rumus matematika, namun lebih melatih dan memperkuat aspek penalaran verbal (logika verbal) dan penalaran numerik (logika matematika) mahasiswa.
b. Belajar logika matematika harus disesuaikan dengan tabel kebenaran yang sudah ditentukan. Secara tidak langsung, mempelajari logika matematika membuat berpikir secara lurus, tepat, dan teratur.
c. Dengan mengasah logika dari sedini mungkin akan membiasakan untuk lebih berpikir kritis dalam menanggapi berbagai masalah. Tidak hanya itu, belajar logika matematika membantu berpikir secara rasional, sistematis, meningkatkan kemampuan berpikir secara objektif dan cermat, serta meningkatkan cinta kepada kebenaran dan menghindari kesalahan- kesalahan berpikir.
d. Logika matematika akan memberikan landasan tentang bagaimana cara kita mengambil kesimpulan
e. Dalam Logika dipelajari metode-metode dan prinsip-prinsip yang dapat dipakai untuk membedakan cara berpikir benar (correct) atau tidak benar (incorrect), sehingga dapat membantu menyatakan ide-ide tepat dan tidak mempunyai arti ganda. Jadi, dalam ilmu logika hanya mempelajari atau memperhatikan kebenaran dan kesalahan dari penalaran, dan penarikan kesimpulan dari sebuah pernyataan atau lebih.

3. Capaian Pembelajaran Mata Kuliah

Capaian pembelajatan mata kuliah Logika Matematika dan Himpunan adalah:

1.1. Mampu menjelaskan konsep pernyataan

1.2. Mampu menjelaskan konsep kalkulus pernyataan

1.3. Mampu menjelaskan konsep kuantifikasi

1.4. Mampu mengidentifikasi keabsahan suatu argumen

Figure 5. The display of the Course Description

4. Lesson Plan (RPS) and competency maps. Here is the display:

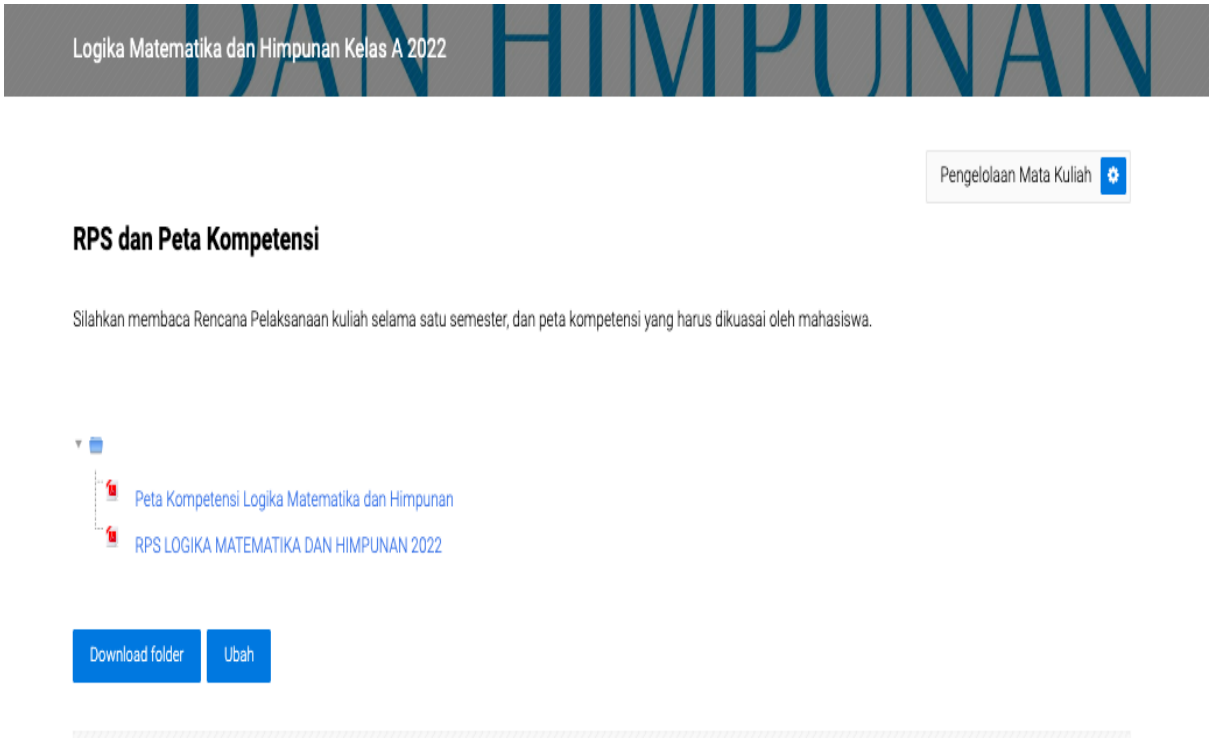


Figure 6. Lesson Plan (RPS) page display and competency map

5. Glossary. Here is the display:

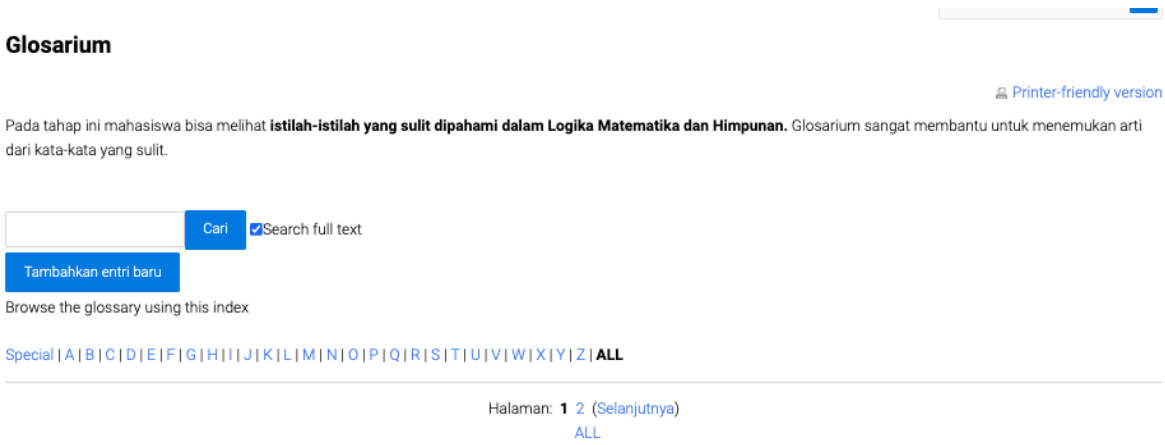


Figure 7. Glossary page display

This e-learning development also has H5P-based educational videos like in the sixth and seventh-week meetings. Here is the display:

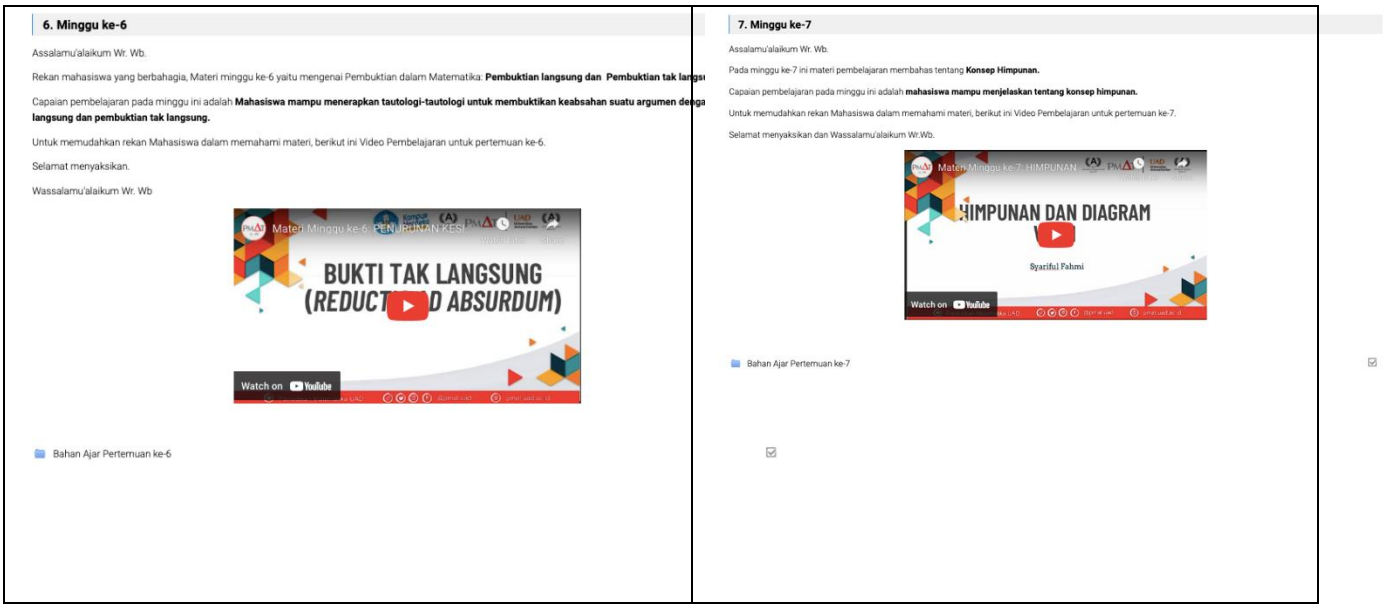


Figure 8. Educational videos for meeting 6 and 7

.

3. EVALUATION

At this stage, material and media experts assessed or validated the educational videos. The assessment results of the material expert can be seen in Table 3. The total average score is 4.23, which means the material in this educational video is in a good category. Meanwhile, the validation results of the media expert can be seen in Table 4. The calculation results show a score of 4.55, which means it is in the very good category.

Table 3. Validation results of material expert

Assessment Aspects	Average
Content aspects	4.26
Language/Communication Aspects	4.31
Collaboration Aspect	4.11
Average	4.23

Table 4. Validation Results of Media Expert

Assessment Aspects	Average
didactic aspect	4.68
aspects of use	4.47
aspects of usability	4.67
benefit aspect	4.38
Average	4.55

Lastly, the educational video also received a response assessment from students, which included four aspects in Table 5; aspects of content quality, grammar, motivation, and use of images and sound. The responses obtained showed an average score of 3.98 which means that it is in the good category.

Table 5. Media Expert Validation Results

Assessment Aspects	Average
Content quality	4.08
Grammar	4.17
Motivation	3.94
Use of images, forums, chat, and video	3.75
Average	4.55

Conclusion

In conclusion, the development of project-based educational videos on mathematical logic and sets materials consists of three stages: design, production, and evaluation. Regarding the product's quality, the material expert's assessment results showed a score of 4.23, which means that it is in the good category, and the media expert assessment scored 4.55 (in the very good category). Lastly, the student's

response during implementation was also very good, scored 3.98 (in the good category).

Acknowledgement

We would like to thank the General Directorate of Higher Education for funding this research activity, Universitas Ahmad Dahlan, Universitas PGRI ty Yogyakarta, and Universitas Muhammadiyah Jember, which have supported the implementation of this developmental research.

References

Hadi. S. (2017. May). Efektivitas penggunaan video sebagai media pembelajaran untuk siswa sekolah dasar. In Seminar Nasional Teknologi Pembelajaran Dan Pendidikan Dasar 2017 (pp. 96-102).

Saman. S.. & Tiro. A. (2019). Pengembangan Video Pembelajaran Matematika Dalam Meningkatkan Minat Dan Prestasi Belajar Siswa Pada Materi Persamaan Linear Dua Variabel. Pedagogy: Jurnal Pendidikan Matematika. 4(1). 1-12.

Putry. H. M. E.. Nuzulul'Adila. V.. Sholeha. R.. & Hilmi. D. (2020). Video Based Learning Sebagai Tren Media Pembelajaran Di Era 4.0. Tarbiyatuna: Jurnal Pendidikan Ilmiah. 5(1). 1-24.

Yudianto. A. (2017). Penerapan video sebagai media pembelajaran.

Sudjana. N & Rivai. A. 1992. Media Pembelajaran. Bandung: Penerbit CV. Sinar Baru Bandung.

Krajcik. J. S.. & Blumenfeld. P. C. (2006). Project-based learning (pp. 317-34). na.

Widyantini. T. (2014). Penerapan Model Project Based Learning (Model Pembelajaran Berbasis Proyek) dalam Materi Pola Bilangan Kelas VII. Artikel Pusat Pengembangan Dan Pemberdayaan Pendidik Dan Tenaga Kependidikan (PPPPTK) Matematika. Diakses. 13.

Hasyim. A. W. (2018). Pengembangan perangkat pembelajaran Matematika Berbasis Proyek dengan menggunakan Vlog (Video Blog) (Doctoral dissertation. UIN Sunan Ampel Surabaya).

Diah Prema Vahini. P. (2021). Pengembangan Video Pembelajaran Interaktif Berbasis Proyek Pada Google Classroom Untuk Meningkatkan Kemampuan Pemecahan Masalah Siswa (Doctoral dissertation. Universitas Pendidikan Ganesha).

Hasyim. A. W. (2018). Pengembangan perangkat pembelajaran Matematika Berbasis Proyek dengan menggunakan Vlog (Video Blog) (Doctoral dissertation. UIN Sunan Ampel Surabaya).

Diah Prema Vahini. P. (2021). Pengembangan Video Pembelajaran Interaktif Berbasis Proyek Pada Google Classroom Untuk Meningkatkan Kemampuan Pemecahan Masalah Siswa (Doctoral dissertation. Universitas Pendidikan Ganesha).

Situmorang. A. S. (2015). Inovasi Model Pembelajaran Berbasis Masalah Untuk Meningkatkan Kemampuan Kreativitas Matematis Mahasiswa Pada Pengajaran Himpunan Dan Logika.