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DEVELOPMENT LEARNING MEDIA E.A.V ON MATHEMATICAL CONNECTION ABILITY OF JUNIOR HIGH SCHOOL

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Abstract

Technological advances that are overgrowing are also one of the challenges for teachers to use technology as a learning medium. Ethnomathematical animation video as a strategy for linking learning in the real world and mathematical connection skills in solving geometry problems. Therefore, this research aims to create an animated video media based on ethnomathematics on mathematical connection abilities in solving problems in class VIII students. This development study uses the ADDIE methodology (Analysis, Design, Develop, Implementation, Evaluation). The results showed that the animated video learning media was adequate, with an overall average score of 3.73 after validation by a Material Expert and an average score of 3.64 after validation by a Media Expert. The responses from the 8th graders were positive (88%) based on the research. Animated video media based on ethnomathematics on mathematical connection abilities can be used as an alternative for teachers in elementary schools to learn geometry material.

Keywords: Animated videos; ethnomathematics; learning media; mathematical connection

Abstrak

Kemajuan teknologi yang berkembang pesat juga menjadi salah satu tantangan bagi guru untuk menggunakan teknologi sebagai media pembelajaran. Video animasi etnomatematika sebagai strategi dalam mengaitkan pembelajaran dalam dunia nyata serta kemampuan koneksi matematis dalam pemecahan masalah materi geometri. Oleh karena itu, tujuan dari penelitian ini adalah untuk membuat media video animasi berbasis etnomatematika pada kemampuan koneksi matematis dalam menyelesaikan masalah pada siswa kelas VIII. Studi pengembangan ini menggunakan metodologi ADDIE (Analisis, design, Develop, Implementasi, Evaluasi). Hasil penelitian menunjukkan bahwa Media Pembelajaran video animasi efektif, dengan skor rata-rata keseluruhan 3,73 setelah validasi oleh Ahli Materi dan skor rata-rata 3,64 setelah validasi oleh Ahli Media. Tanggapan dari siswa kelas 8 adalah positif (88%) berdasarkan penelitian. Media video animasi berbasis etnomatematika pada kemampuan koneksi matematis dapat dijadikan salah satu alternatif bagi guru di sekolah dasar dalam belajar materi geometri.

***Kata kunci**: Etnomatematika; Koneksi Matematika; Media pembelajaran; Video Animasi*

INTRODUCTION

Advanced education equips students with the skills to acquire the characters and competencies needed by themselves, the community, and their nation spiritually, religiously, disciplined, personable, intellectually, and virtuously (Darmayanti, 2022;

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Evalina et al., 2021; Kunanusorn, 2021). It must be done to create a learning environment and system that allows dynamic development. In essence, education encourages humans to develop their skills in order to be able to face the changes brought about by technological advances (Pavlovičová & Bočková, 2021; Sugianto et al., 2022; Syaifuddin et al., 2022).

Rapid technological advances are also one of the challenges for teachers to use technology as a learning medium (Choirudin et al., 2021; Hämäläinen et al., 2021; Saien et al., 2019). Learning media can be used to communicate learning messages from teachers to students (or vice versa), thus making the learning process more effective (Canedo et al., 2020; Giurgiu & Gligorea, 2017; Haviland et al., 2021). Therefore, if the appropriate learning media is provided, it can increase students' interest in learning and improve the quality of teaching (DP Utomo et al., 2023; Hasanah, et al., 2022; Haviland et al., 2021).

Based on observations and unstructured interviews at SMP YALC Pasuruan Grade 8, the ability to connect mathematics subjects, relationships between mathematics and other subjects, and everyday life shows that these skills are still lacking in all students. Students also have difficulty understanding the internal and external relationships between concepts and ideas. Students cannot make mathematical connections to solve mathematical problems (Sekaryanti et al., 2023; Suherman et al., 2021). A monotonous learning environment can cause these problems. This is because many teachers still use learning methods and media that are still relatively old, for example, using videos from other people's *YouTube links*. In addition, the *YouTube video content* given to students does not address problems in class. To achieve learning objectives effectively and efficiently, media is needed to act as a tool to facilitate the learning process (Anwar et al., 2019; Hasanah, et al., 2022). One of the learning media that helps students better understand the material presented in *online* and *offline learning* is animated videos.

Ethnomathematics in geometry or spatial learning has been carried out by (Oktarina et al., 2019) by developing guided discovery-based worksheets to improve student learning outcomes of the Joglo traditional house. (Rachmawati & Purwaningrum, 2019) Using the discovery learning model to grow mathematical literacy in the traditional house of the Sasak area. (Dama et al., 2021) by developing PBL teaching materials to improve the understanding ability of junior high school students using literature studies. (Dinata et al., 2021; Krismonita et al., 2021) It developed students' worksheets to improve student learning outcomes and motivation using red bricks and the Great Temple of Gumuk Kancil Banyuwangi. (Herdian et al., 2019) Use an approach based on APOS theory to improve students' conceptual understanding skills. (Dhiki, 2019) uses Wolotopo traditional musical instruments to understand mathematical concepts. As well as research conducted by (Faqih et al., 2021), that is, by developing interactive multimedia with traditional Cirebon cooking utensils.

Research related to video animation as a learning medium for building materials has been carried out by (Lubis et al., 2020), focusing on the spatial abilities of junior high school students. (Mashuri & Budiyono, 2020), Developed to improve the learning

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outcomes of elementary school students. (Hapsari & Zulherman, 2021) increase the motivation and learning achievement of elementary school students. (Widiyasanti & Ayriza, 2018) Increase the learning motivation of elementary school students. (Sudiarta & Sadra, 2016) See the effect on problem-solving ability and understanding of students' concepts. (Hartina, 2020), with the help of the Powtoon application to improve the understanding ability of junior high school students.

Therefore, the novelty of this research lies in the development of ethnomathematics-based animated video learning media on the mathematical connection skills of junior high school students in solving geometric mathematic problems.

RESEARCH METHODS

The type of research conducted is research and development (R&D) used to create products, find ways to develop mathematics learning media, and measure the effectiveness of media for use in learning. The process of developing this research uses learning design using the ADDIE model developed by Robert Maribe Branch. The ADDIE model extends analysis, design, development, and implementation. And assessment (evaluation/feedback). An overview of the ADDIE development model is in Figure 1.

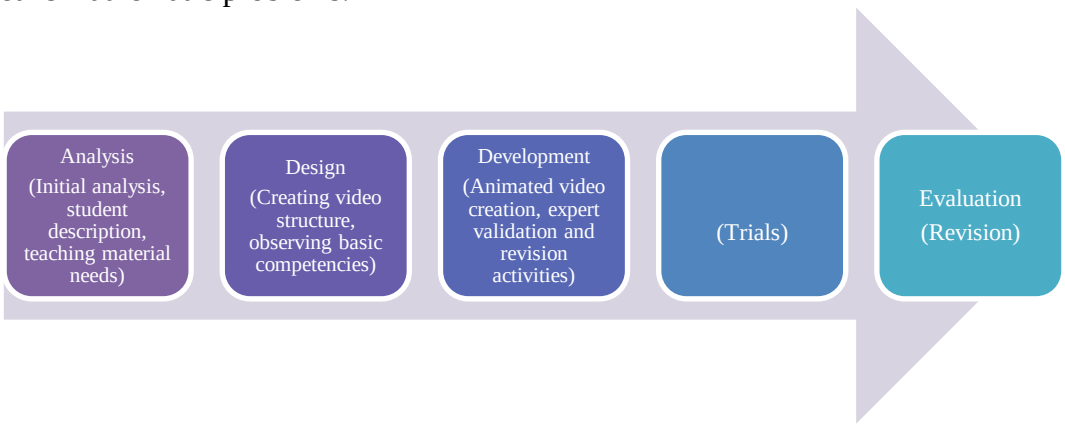

Figure 1. ADDIE model development (Darmayanti et al., 2022)

Then the processes that will be carried out are (1) *analysis* (the formation process, which includes initial and final observations, student observations, task observations, and the formulation of learning objectives), (2) *design* (the formation process, namely the process of designing animated videos that are in *sync* with the spatial material the flat side of the 2013 curriculum, (3) *develop* (manufacturing process which includes expert validation and product revision), (4) implementation (product testing process), and the last process is product evaluation (*improvement*) after use.

The product developed in this study is a geometrical mathematics learning media based on ethnomathematical animation videos on mathematical connection abilities for class VIII students of SMP YALC Pasuruan and through data using qualitative descriptive techniques after using comics for mathematics learning tools in the form of student responses through questionnaire sheets and learning outcomes tests through test

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sheets. Student response sheets and test sheets were given to 24 eighth-grade students of the Assyfa Learning Center Foundation, which were then quantified to get the results in the form of numbers which will be measured by making animated videos as teaching materials. The Likert scale is used as an evaluation tool to check the effectiveness of the media used. Validation is done to determine the feasibility of the learning media developed before testing with learning activities. The Likert scale is in Table 1.

Table 1. Likert Scale

Answer Options	Score
Strongly disagree	1
Disagree	2
Disagree	3
Agree	4
Very disagree	5

Material Validation

Material validation was carried out by two validators (two mathematics teachers). The material approval sheet grid is in Table 2.

Table 2. Grid of material validation sheets

Num	Viewpoint	Instruction	Questions
1	Material integration	The suitability of the material, questions, and sample questions	1, 2
		Shape and size	3, 4
2	Contents	Illustration	5, 6, 7
		Storyline	8, 9, 10, 11
3	Language	language compilation	12, 13, 14, 15

Table 3. Grid of the validation sheet for teaching materials

Num	Viewpoint	Instruction	Questions
1	Contents of the video	Clarity of objectives and suitability of learning indicators	1, 2, 3
		The suitability of the material, the suitability of the illustration with the material, the systematic presentation of the material	4, 5, 6, 7,8
		Language used	9, 10, 11
2	Appearance	Video view	12, 13, 14
		Font compatibility and font size	15, 16
		Accuracy of video accompaniment music, text legibility, picture quality, and sound quality	17, 18, 19, 20
		Selection of video animation, color, attractiveness	21, 22, 23, 24, 25

Media Validation

Media validation is carried out by two validators (one mathematics teacher and one computer teacher)—the validated media grids are in Table 3. Then, based on the items validated in Table 3, if the results show a minimum value with a "valid" category, the product can be used in the learning process.

Student Response

A questionnaire of student responses after using the media was used to determine the practicality of the media—questionnaire grid student responses in Table 4.

Table 4. Grid of student response

Viewpoint	Questions
Interest in animated videos	1, 2, 3, 4, 5, 6
Material Retention	7, 8, 9, 10
Appearance	11, 12, 13

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The calculating formula, the average validation score, uses the formula (mean instrument score with a percentage system) with the total score of response responses in each unit divided by the total response of each unit. Then based on the items validated in Table 4, if the results show a minimal value in the "practical" category, the product can be said to be practical.

Learning outcomes

Questionnaires are used to see the results of student development after using animated videos as a learning tool. The questionnaire, in the form of three questions, contains instructions for mathematical connection abilities and is given separately from the animated video, which will then be measured based on Polya's completion steps. Indicators of students' critical thinking skills and the classification of Polya's stages can be seen in Tables 5 and 6.

Table 5. Grid of students' critical thinking ability

Num	Indicator	Questions
1	Recognize and use the connections between mathematical ideas	1
2	Understand how mathematical ideas are linked and built on one another	2
3	Recognizing and using mathematics in contexts outside of mathematics	3

Table 6. Classification of Polya stages

Num	Indicator	Description
1	Understanding the Problem	Students to work on problems must first have the initial ability to understand the problem to determine the strategy to solve the problem.
2	Planning a Plan	Students can use the ability to make plans or strategies by choosing the formula to use through their reasoning in selecting and sorting out which formula to use.
3	Executing the Plan	Students can carry out the plans prepared at the planning stage by calculating through a predetermined formula.
4	Reviewing Results	Students can review the results they have written on the answer sheet by making a conclusion or re-evidence that is useful for checking whether what has been done is correct.

The results of student learning after using animated video media can be calculated to test the effectiveness of the media, namely by calculating the completeness of learning individually and as a whole. Individual learning completeness is based on the KKM value set by the school of 75. The following formula calculates the level of complete learning in a class: the number of students who have completed learning is divided by the total number of students, and the result is multiplied by one hundred percent.

RESULTS AND DISCUSSION

Animated video learning media developed using the ADDIE model. The model consists of five stages, namely the definition stage, the design stage, the development stage, the implementation, and the evaluation stages. The explanation is described as follows:

Stage Analysis

The analysis phase starts with analyzing the widespread problems that arise in learning *and* consulting with mathematics teachers at the Assyfa

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Learning Center Foundation on learning mathematics activities using the *Lesson Study method*. The problems found during the learning activities were a lack of interest in learning students and a lack of interpretation and perception among junior high school students. Junior high school subjects at the Assyfa Learning Center Foundation attend different schools. Some go to public, private, and boarding schools. The causative factors include students being bored with schools that still use learning videos from other people's YouTube to be studied at school and home by students because the videos used are not exciting and do not match the problems at school. Videos whose delivery methods are not understood by students because they are too fast and difficult to understand. The examples of illustrations used are also not related to students' real lives, such as approaches in a cultural context, so they can attract students' attention and make student learning outcomes low. The many complaints from students evidence that if mathematics is complex, the teacher only gives a *link video of* learning for students to watch without being explained or any feedback from the teacher to review the material. Teachers do not understand how to use technology-based media because almost all of their mathematics teachers lack knowledge of technology. Teachers are wasted energy and time because they have to teach, so they don't have time to make learning media or learning videos.

Description of students observing how to learn mathematics in class VIII of the Pasuruan Assyfa *Learning Center Foundation.* Students stated they could learn and understand well by connecting the questions and the previous material and applying their knowledge to solve mathematical problems. It was found that students had problems connecting their mathematical abilities in solving problems.

Studying LKS almost all LKS used in their schools are the same. The teacher does not provide other media besides worksheets, so through the development of media according to the journals studied in the chapter on building spaces, especially Geometry on cube and block material. It is very appropriate to use in making animated videos. Results of interviews and discussions with other mathematics teachers who teach at the Assyfa *Learning Center Foundation* on block and cube material must be improved. Furthermore, the integration process of learning activities, according to the 2013 curriculum, uses essential competencies 3.9 and 4.9 with an indicator of 3.9.1 to determine the surface area of blocks and cubes. While indicator 4.9.1 is the indicator of solving everyday problems related to the surface area of blocks and cubes.

Stage *Design*

The process of making (the model) starts with making a video structure and observing the initial skills or (KD) comparative subjects of the 2013 curriculum. Observation requires more than once, and the formation of initial skills or (KD) and instructions used in comics get packaged results in Table 7.

Table 7. Initial capability and yield index.

Basic Competences	Indicators of Competence
3.9 Distinguish and determine the surface area and volume of flat shapes (cubes, blocks, prisms, and pyramids)	3.9.1 Determining the surface area of Blocks and Cubes

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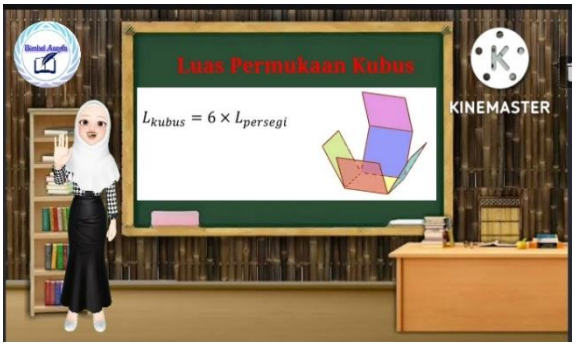
Basic Competences	Indicators of Competence
4.9 Solve problems related to surface area and volume of plane figures (cubes, cubes, primes, and pyramids), and their combinations	4.9.1 Solve everyday problems related to the surface area of blocks and cubes

After determining the essential competencies (KD) and index results based on table 7, make an animated video titled "Learning Geometry from Candi Jawi". Make an initial sketch of an animated video in the *kinemaster app*, as shown in Figure 2. In this application, stickers, text, layers, music, display effects, and other features are available to support video creation.

Figure 2. Kinemaster application for creating animated videos

Development Stage

In this study, the finished animated video design will then enter the development stage, which consists of expert validation and trial activities—display animated video media containing ethnomathematical-based geometry material on mathematical connection abilities in Figures 3.



Figures 3. Learning videos containing ethnomathematics and exercises on mathematical connection questions

Expert validation consists of material expert validation and media expert validation. The results of material validation obtained from the two validators are presented in Table 8. At the same time, the results of media validation were carried out by two validators (two media experts in their fields). The validator investigated by filling out the material verification sheet using a four-choice Likert scale (4 = perfect, 3 = good, 2 = regular, 1 = a little) which is presented in Table 8.

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Table 8. Results of material validation data analysis

Viewpoint	Validation Average	Information
Material integration	3.67	Very good
Contents	3.71	Very good
Language	3.54	Very good

Based on table 8, the average overall validation of the material in the table above is 3.64, an instrumental category (very valid). In short, animated video media contains quality material that must be tested.

Table 9. Results of Media Validation Data Analysis

Instruction	Validation Average	Information
Video Content	3.82	Very good
Appearance	3.65	Very good

Based on Table 9, the average total media validation is 3.73 with a suitable category (valid), which means that animated video media is feasible to be tested. In the validation process that has been carried out, there are several criticisms and suggestions for improving animated video media.

Implementation

A trial of ethnomathematics-based animated video media on mathematical connection abilities that have been revised based on the validation results will then be tested on 2 4 students in class VIII, the Assyfa *Learning Center Foundation*. This media trial was conducted on 18-19 August 2022 for 80 minutes (2×40 minutes) to find out the practicality and effectiveness of the animated video media that has been developed. At the end of the activity, students are given a test containing mathematical connection abilities to work. In addition, the teacher also gave a response questionnaire after using the animated video. The teacher will analyze the data obtained from the test and the response questionnaire. The result can be seen in Table 10.

Table 10. Results of student response analysis

Viewpoint	Average	Category
Interest in animated videos material retention Appearance	89%	Very Practical

Based on Table 10, student responses were measured based on data obtained from filling out response questionnaires by 24 subjects; the average percentage of student responses was 89% with a very positive category, which means that students like using animated videos as learning media. Then, to determine the effectiveness of the media can be seen in Table 11.

Table 11. *Results of student response analysis*

Completed Student	Unfinished students	Average	Category
21 students	3 students	88%	Very effective

Value of student learning outcomes The results obtained from the test with five questions given separately from the digital animation video will then be analyzed according to the minimum completeness criteria (KKM) used by the

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Asyifa Learning Center Foundation, which is 75. Based on Table 11, the results show that all students get scores above the KKM or more than the same, with 75 with a percentage of 88% with a very effective category. Meanwhile, the learning outcomes measured are based on Polya's completion steps.

Evaluation

Based on the data analysis in this study, all of them can meet all the indicators of Polya's steps and pass the KKM, which are adjusted to those used by the school so that this animated video media can help and facilitate the learning process. learning program (Haagsman et al., 2020). The quality of the animated video as a learning media is said to be good if it meets three criteria, namely valid (worth trying), practical (easy to use as measured by student questionnaires), and practical (facilitating learning as measured by student learning outcomes tests). (Andi Mattoliang et al., 2022; Nuritha & Tsurayya, 2021). (Bustanil S et al., 2019) states that animated videos as compiled teaching materials can better refer to the validity of documents and the opinions of teachers and students who show that the material is appropriate and easy to use.

D'Ambrosio stated that ethnomathematics has one goal: to learn how students understand, articulate, process, and ultimately use mathematical ideas, concepts, and practices and are expected to solve problems related to their daily activities. Ethnomathematics integrates culture-based mathematics into mathematics lessons. So it can be explained that ethnomathematics is a mathematical discipline that uses ideas, concepts, and practices in the culture of a society, which are then integrated into the classroom. In the era of development, most students tend to forget the culture of Indonesia. Students prefer to learn through electronic means such as the internet and devices, mostly exposed to foreign cultures (Czerniewicz, 2017). Through an e-book with a book creator application that contains cultural elements, it is hoped that it can instill cultural elements into the lessons and lives of students. This is based on the (Mursalina & Retta, 2021) statement that through ethnomathematics, students can be helped to understand more about reality, culture, society, and themselves.

Ethnomathematics aims to learn how students understand, articulate, process, and ultimately use mathematical ideas, concepts, and practices and is expected to solve problems related to their daily activities. Meanwhile, according to (Archibald et al., 2019; Sari et al., 2019), ethnomathematics integrates culture-based mathematics into mathematics lessons. So it can be explained that ethnomathematics is a mathematical discipline that uses ideas, concepts, and practices in the culture of a society, which are then integrated into the classroom. In the era of development, most students tend to forget the culture of Indonesia. Students prefer to learn through electronic means such as the internet and devices mostly exposed to foreign cultures (Tackett et al., 2021). Through an e-book with a book creator application that contains cultural elements, it is hoped that it can instill cultural elements into the lessons and lives of students. This is based on (Zhang et al., 2020) statement that through ethnomathematics, students can be helped to understand more about reality, culture, society, and themselves.

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their daily activities. Meanwhile, according to Brandt & Chernoff (Patri & Heswari, 2021), ethnomathematics integrates culture-based mathematics into mathematics lessons. So it can be explained that ethnomathematics is a mathematical discipline that uses ideas, concepts, and practices in the culture of a society, which are then integrated into the classroom. In the era of development, most students tend to forget the culture of Indonesia. Students prefer to learn through electronic means such as the internet and devices, mostly exposed to foreign cultures (Schabarum & Chishman, 2020; Vidyastuti et al., 2022). Through an e-book with a book creator application that contains cultural elements, it is hoped that it can instill cultural elements into the lessons and lives of students. This is based on (Supriyatin et al., 2019) statement that through ethnomathematics, students can be helped to understand more about reality, culture, society, and themselves.

Animated video research related to mathematical connection abilities has been carried out by (Erna, Isfayani; Hayatun, Nufus, Sri, 2021), applying the problem-based learning model. However, the material used is SPLTV, not geometry, then the subjects used are SMK students, not SMP students. As well as animated videos used from other people's videos.

Research on animated videos associated with ethnomathematics and mathematical connection skills has not been studied. Therefore, researchers are interested in developing learning media based on ethnomathematical animation videos on the mathematical connection abilities of junior high school students in flat-sided geometry. Where in the animated video it is explained in the context of the cultural story of the historical site of Singosari, East Java. Implementation of learning tools made about the historical site of the Singosari kingdom by using examples of ethnomathematics are; (1) *Jawi Temple*, on the roof of the interpretation of pyramid and cube properties, (2) *Yoni*, with beam properties, (3) *Patra Punggel*, with rectangular properties, (4) *Land around the temple*, using the formula rectangular, (5) *The fence around the temple*, also has beam properties, all objects can be observed directly to find out the mathematical value contained in it so that this study aims to describe the process of developing animated videos as an ethnomathematics-based learning media on mathematical connections, responses, and student learning outcomes after using the media. Based on previous research, no research has developed an ethnomathematical-based animated video media about mathematical connection skills in solving mathematical problems.

This research aligns with (Agustina & Zulkardi, 2021; Listiawati & Qomariah, 2020), helping the learning process and improving student learning outcomes, requiring quality learning materials according to their needs, being accepted by students, and facilitating the student learning process. (Amrullah et al., 2021; Febliza et al., 2021) Suitable media is valuable in media and materials and can be used in learning. It can be seen from the study results that the ethnomathematics-based animated video "Learning Geometry from Candi Jawi" is a developed learning media. It can be said to have good quality in terms of grades, positive student feedback, and overall student learning outcomes.

CONCLUSION

The ethnomathematics-based animation video learning media on the mathematical connection ability of the spatial material has obtained very valid

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results for material experts. Meanwhile, media experts stated that it was valid. In the test results on class VIII junior high school students, the results of student responses were a very positive category, meaning that students like using comics as learning media. In the learning outcomes in this study, all of them met all the indicators of Polya's steps and passed the KKM, which were adjusted to those used by the school so that this animated video media could help and simplify the learning process. Therefore, the ethnomathematics-based animated video media on mathematical connection abilities can be used as an alternative for teachers in learning building materials and developing this media for other materials. For further research, it was combining learning models with ethnomathematics-based animated videos.

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