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INTEGRATING ETHNOMATHEMATICS AND HIGHER-ORDER THINKING SKILLS IN INTERACTIVE ANIMATION MEDIA TO FOSTER STUDENTS' CRITICAL THINKING

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Abstract

Critical thinking skills in mathematics are still relatively low in Indonesia. One of the causes is the lack of practice and habituation in working on critical thinking problems. To overcome this, innovations in learning are needed that not only improve critical thinking skills but also link mathematical concepts to local culture through ethnomathematics. The purpose of this research is to develop a valid, practical, and effective critical thinking and ethnomathematics based interactive animation video to improve students' critical thinking ability. The research method used is Research and Development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Data collection techniques through observation, interviews, questionnaires, and critical thinking ability tests. Participants include students, teachers, and expert validators. Effectiveness was determined by analyzing the improvement of critical thinking skills in the experimental group and comparing the posttest results with the control group using N-Gain and an independent sample t-test. The experimental group achieved an average N-Gain of 0.62, indicating a moderate improvement, and a significantly higher posttest score (86.33) than the control group (75.48), with a Sig. (2-tailed) value of 0.000 < 0.05. These results indicate that the interactive animation video media based on HOTS and ethnomathematics developed is effective in improving students' critical thinking skills. This research contributes to the development of learning media based on theory and technology, as well as offering practical insights for future innovations in mathematics education.

Keywords: animation video; critical thinking skills; ethnomathematics; HOTS; interactive media.

Abstract

Higher Order Thinking Skills (HOTS) dalam matematika masih tergolong rendah di Indonesia. Salah satu penyebabnya adalah kurangnya latihan dan pembiasaan dalam mengerjakan soal HOTS. Untuk mengatasi hal ini, diperlukan inovasi dalam pembelajaran yang tidak hanya meningkatkan keterampilan berpikir kritis tetapi juga mengaitkan konsep matematika dengan budaya lokal melalui ethnomathematics. Tujuan penelitian ini adalah untuk mengembangkan video animasi interaktif berbasis HOTS dan etnomatematika yang valid, praktis, dan efektif untuk meningkatkan kemampuan berpikir kritis siswa. Metode penelitian yang digunakan adalah Research and Development (R&D) dengan model ADDIE (Analysis, Design, Development, Implementation, dan Evaluation). Teknik pengumpulan data melalui observasi, wawancara, kuesioner, dan tes kemampuan berpikir kritis. Partisipan meliputi siswa, guru, dan validator ahli. Efektivitas ditentukan dengan menganalisis peningkatan kemampuan berpikir kritis pada kelompok eksperimen dan membandingkan hasil posttest dengan kelompok kontrol menggunakan N-Gain dan uji-t sampel independen. Kelompok eksperimen mencapai rata-rata N-Gain sebesar 0,62, yang menunjukkan peningkatan sedang, dan skor posttest yang secara signifikan lebih tinggi (86,33) dibandingkan kelompok kontrol (75,48), dengan nilai Sig. (2-tailed) sebesar 0,000 < 0,05. Hasil ini menunjukkan bahwa interactive animation video media berbasis hots dan ethnomathematics yang dikembangkan efektif dalam meningkatkan kemampuan berpikir kritis siswa. Penelitian ini berkontribusi pada pengembangan media pembelajaran berbasis teori dan teknologi, serta menawarkan wawasan praktis untuk inovasi masa depan dalam pendidikan matematika.

***Kata kunci**: Animation video; ethnomathematics; HOTS; interactive media; kemampuan berpikir kritis.*

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INTRODUCTION

Mathematics is an essential subject for developing students' logical and critical thinking skills. Mathematical critical thinking skills encompass students' abilities to analyze, evaluate, and solve mathematical problems logically and systematically (Bintoro et al., 2021; Cortez et al., 2023; Maričić & Špijunović, 2015). Critical thinking skills are a fundamental part of Higher Order Thinking Skills (HOTS), because they involve the skills of analyzing, evaluating, and creating complex solutions in solving problems, including in the context of mathematics learning.

Higher Order Thinking Skills (HOTS) are higher-order thinking skills that include the ability to analyze, evaluate, and create something new based on existing knowledge. HOTS encourages students to think critically, logically, reflectively, metacognitively, and creatively in solving problems that are not merely memorizing or understanding concepts simply, but also applying them in various contexts, including in mathematics learning and everyday life (HS Bintoro et al., 2021; Anggoro et al., 2025; Xiao et al., 2025; Özkan Kunduracı et al., 2024; Affandy et al., 2024). However, evaluation results show that elementary school students' HOTS skills are still low This is supported by several studies, which show that elementary school students' average higher-order thinking skills remain low (Rahmawati et al., 2022; Affandy et al., 2024).

Researchers conducted preliminary research in several elementary schools to examine students' critical thinking skills in mathematics learning. The results show that students' critical thinking skills are still relatively low, as most students rely on procedural problem solving and experience difficulties when dealing with problems that require analysis and reasoning. Classroom observations also indicate that the learning media used are still conventional and teacher-centered, resulting in limited student engagement in the learning process. These findings are consistent with previous studies which state that learning media that do not actively involve students and do not connect mathematical concepts with local cultural contexts can hinder the development of students' higher-level thinking skills (Bintoro & Zuliana, 2015; Bintoro, Sukestiyarno, et al., 2023; Therefore, innovative learning approaches are needed, one of which is ethnomathematics that integrates mathematical concepts with local culture and has been shown to improve students' mathematical communication and conceptual understanding (Bintoro et al., 2024).

To address this issue, innovative learning media are needed to increase student engagement and support the development of critical thinking skills. One potential solution is the use of animated video media integrated with Higher Order Thinking Skills (HOTS) and ethnomathematics. Animated videos can present abstract mathematical concepts in a more visual and engaging way, making them easier for students to understand. In addition, the integration of ethnomathematics connects mathematical concepts with students' cultural contexts and daily experiences, making learning more meaningful and relevant.

The aim of this research is (1) to develop interactive animation video media based on HOTS and ethnomathematics, 2) analyzing the validity and practicality of interactive animation video media based on HOTS and ethnomathematics, and (3) analyzing

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the effectiveness of interactive animation video media based on HOTS and ethnomathematics to improve critical thinking skills of elementary school students.

The urgency of this research lies in the need for innovation in mathematics learning media that is not only interactive and technology-based but also integrates HOTS and ethnomathematics approaches to improve elementary school students' critical thinking skills.

METHODS

The study was conducted on sixth-grade students at MI Mansyaul Ulum and MI Bustanul Ulum, while MI Thoriqotul Ulum served as the control class. Focus of this research is about students' critical thinking skills in the circle material.

This research applies the research and development method. In the research and development process to be carried out, researchers use the ADDIE model. This ADDIE model is structured into five stages that need to be followed in its implementation, including: (1) analysis, (2) design, (3) development, implementation, and (5) evaluation (Sugiyono, 2019; Sukestiyarno, 2020; Creswell, 2014).

The product developed from this research is an interactive HOTS and ethnomathematics-based animation video media to improve students' critical thinking skills. The development procedure for this learning video uses the ADDIE model (Spatioti et al., 2022). The following are the stages of the ADDIE model development procedure.

1. Analysis

The analysis stage aimed to identify instructional needs related to students' critical thinking skills in mathematics learning. The researcher conducted a curriculum review to determine relevant competencies and learning objectives aligned with Higher-Order Thinking Skills (HOTS). Classroom observations and teacher interviews were carried out to examine students' characteristics, prior knowledge, and learning difficulties, particularly in solving contextual and non-routine problems. Existing instructional media were also reviewed to identify gaps in supporting critical thinking. In addition, relevant local cultural elements were explored to ensure meaningful integration of ethnomathematics. The findings of this stage informed the pedagogical and technical specifications of the interactive animation media.

2. Design

The product that will be designed and developed is an interactive Animation video media based on HOTS and ethnomathematics, a form of media that can improve students' critical thinking skills. This video will cover learning objectives, materials, example questions, and practice questions. This design stage involves four steps: 1) creating a story a board that includes a sketch or screen image including pages and frames; 2) arranging the material in the learning media, including the layout that will be used; 3) making a learning implementation plan that includes the sequence of material that will be delivered; and 4) making student worksheets that refer to the learning material that is visualized through animated mathematics learning videos.

3. Development

This feasibility test is conducted to assess the extent to which the developed product can be used effectively in the learning process. The validators involved in the product

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feasibility test include subject matter experts and media experts. The primary objective of this feasibility test is to evaluate the quality of the content and learning objectives, learning strategies, instructional materials, and media design. At this stage, revisions are also made to any aspects that are still suboptimal based on input, criticism, and suggestions provided by the validators.

4. Implementation

The next step is the implementation phase, which will be conducted on a limited and large scale in the schools selected as research locations. Researchers will conduct the learning process using the developed learning media while conducting observations that can be used to improve the learning media. After the learning session is complete, students are expected to take a test that assesses critical thinking skills, which is structured based on indicators of these abilities. The purpose of this test is to evaluate the extent to which the developed learning media has effectively improved students' critical thinking skills.

5. Evaluation

The evaluation stage involved comprehensive analysis of quantitative and qualitative data obtained during implementation. Validation results, practicality measures, and learning outcome data were analyzed to determine the levels of validity, practicality, and effectiveness. Qualitative feedback from experts, teachers, and students was used to identify areas for refinement. Final revisions were conducted to optimize both pedagogical and technical aspects of the media. The resulting product is an interactive animation media integrating ethnomathematics and HOTS that is empirically supported as valid, practical, and effective in enhancing students' critical thinking skills.

According to Budiyono (2019). The data collection instruments used in this study are as follows:

1. Observation Sheet

Observation sheets are given to observers (researchers and colleagues) to conduct observations during learning activities using interactive HOTS and ethnomathematics-based animation video media. This guideline is used to summarize data related to the use of interactive media. Animation video media based on HOTS and ethno-mathematics and improving students' critical thinking skills.

2. Questionnaire Sheet

A questionnaire was used to evaluate the validity of the product by experts and practitioners and to assess student and teacher responses to the use of the media. The instruments applied included (1) product validity assess-ments by experts and practitioners, and (2) student and teacher response instruments related to the media.

3. Test

The test used is a mathematical critical thinking skills test. Tests are used to determine the effectiveness of interactive Animation video media based on HOTS and ethnomathematics when tested on a large scale.

Data analysis in this study was conducted systematically in accordance with the research objectives, which included analyzing needs, validity, practicality, and effectiveness of the developed media (Budiyono, 2019). The needs analysis data were obtained from questionnaires, documentation, class-room observations, and literature reviews. These data were analyzed

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descriptively and qualitatively through data reduction, categorization, and interpretation to identify instructional problems, students' difficulties in developing critical thinking skills, and the necessity of developing interactive animation media integrating HOTS and ethnomathematics. The results of this analysis formed the basis for determining product specifications and development priorities.

The feasibility (validity) of the developed media was analyzed quantitatively using percentage-based analysis derived from expert validation scores. The percentage of validity was calculated by comparing the total score obtained with the maximum possible score, then interpreted according to predetermined validity criteria. The validity criteria were classified as follows: 3.25–4.00 (very valid), 2.50–3.24 (valid), 1.75–2.49 (sufficiently valid), and 1.00–1.74 (invalid). Qualitative feedback from subject matter experts and media experts was analyzed descriptively and used to revise and refine the product.

The practicality data were collected through student response questionnaires and classroom observation sheets during the implementation phase. The practicality criteria were classified as follows: 3.25–4.00 (very practical), 2.50–3.24 (practical), 1.75–2.49 (less practical), and 1.00–1.74 (not practical). These criteria indicate the level of usability, clarity of instructions, and attractiveness of the media in supporting the learning process.

To measure effectiveness, students' critical thinking skills were assessed using pre-test and post-test instruments administered to the experimental and control groups. The improvement in learning outcomes was analyzed using the normalized gain (N-gain) formula to determine the level of students' score improvement. Furthermore, differences in critical thinking skills between the experimental group and the control group were tested using an independent sample t-test. Prior to conducting the hypothesis test, normality and homogeneity tests were performed to ensure that the data met the assumptions required for parametric statistical analysis. All statistical analyses were conducted at a significance level of 0.05.

Through these procedures, the developed interactive animation media integrating ethnomathematics and HOTS was evaluated in terms of validity, practicality, and effectiveness in fostering students' critical thinking skills.

RESULTS AND DISCUSSION

In the preliminary study, researchers conducted interviews with students and teachers so that they could be used as a basis for developing interactive learning. Animation video media based on HOTS and ethnomathematics. There are five stages in the interactive development process. Animation video media based on HOTS and ethnomathematics. The five stages of research according to the ADDIE model include: (a) analysis, (b) design, (c) development, (d) implementation, and (e) evaluation.

a. Analysis

The analysis stage was conducted by conducting interviews and observations with sixth-grade students and teachers at MI Mansyaul Ulum, MI Bustanul Ulum, and MI Thoriqotul Ulum in Pati Regency. Before conducting the interviews, the researcher prepared an interview instrument to be used as a guideline for interviews with teachers and students to

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collect various information. The results of these interviews and observations were used as guidelines for the preliminary study of the research. The researcher conducted interviews and observations during mathematics learning activities and found that students had difficulty working on problems in the form of stories because they could not turn them into mathematical sentences, and students' critical thinking skills were still low because students only memorized formulas without understanding the concepts and their applications. Teachers used teaching materials that were not varied. This resulted in students being less enthusiastic in the learning process in class.

b. Design

The design in this research aims to facilitate the development of interactive Animated video media based on HOTS and ethnomathematics will be developed. This design phase involves analyzing the interview results from the preliminary study. After that, consultations will be held with the supervising lecturer regarding the interactive design. Animation video media based on HOTS and ethnomathematics to improve the problem-solving skills of sixth-grade MI students. Previously, the researcher determined learning outcomes, formulated learning objectives, analyzed the culture in Kudus Regency, and compiled learning materials. Then, they developed assessment instruments and created interactive designs. Animation video media based on HOTS and ethnomathematics.

c. Development

After the design phase, the initial product draft development stage begins. This initial product draft was developed by analyzing the research subjects and interactive components. Animation video media based on HOTS and ethnomathematics. The results of the initial product draft development can be seen in Table 1.

Table 1. Initial product draft development

Analysis	Results Analysis	Planning
Research subjects	1. The student has not yet questioned the description because it cannot be changed into a mathematical sentence. 2. The teacher has not used it yet interactive An interesting animation video media based on HOTS and ethnomathematics.	The researcher selected two classes by testing their homogeneity. The experimental class is student class VI MI Bustanul Ulum. The control class is student class VI MI Thoriqotul Ulum.
Interactive components animation video media based on HOTS and ethnomathematics.	Interactive HOTS and ethnomathematics-based animated video media are designed to be as engaging as possible to engage and engage students.	1. Interactive animation video media based on HOTS and ethnomathematics is one of the choices that teachers can make according to the current problems of sixth-grade students.

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Analysis	Results Analysis	Planning
	Furthermore, interactive Animation video media based on HOTS and ethnomathematics is compiled by linking ethnomathematics to help improve students' critical thinking skills. Sixth-grade elementary school students.	2. How interactive works Animation video media based on HOTS and ethnomathematics connects the culture of the Kudus area to mathematics learning, both in terms of material and evaluation. This way, students can grasp concepts by linking them to the surrounding culture/customs.

Development of the initial product draft, namely determining the interactive components Animation video media based on HOTS and ethnomathematics. This media consists of three parts:

1) The initial section contains the media identity. The home page display can be seen in Figure 1.

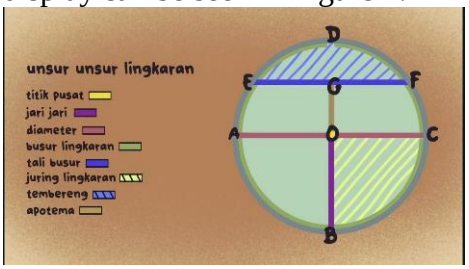

Figure 1. Home page

2) The core section contains learning materials. The appearance of the in-depth material page can be seen in Figure 2

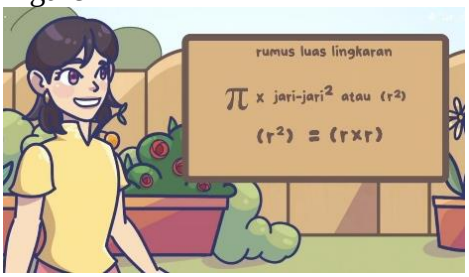

Figure 2. Material in-depth page

3) The final part is, learning evaluation. The evaluation page display can be seen in Figure 3.

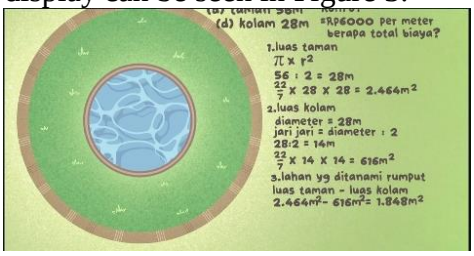

Figure 3. Evaluation page

Researchers design interactive designs. The animation video is linked to the culture in Pati Regency, which is in accordance with the learning material to be delivered, namely "Circles." This study aims to describe the use of interactive HOTS-based animation video media and ethomathematics are linked to the learning of circle material in sixth-grade elementary school using the Merdeka Curriculum. The researchers then analyzed learning outcomes and formulated appropriate learning objectives. The results of the analysis of learning achievements and objectives can be seen in Table 2.

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Table 2. Analysis of learning achievements and objectives

Element	Achievements Learning	Objective Learning
Geometry	1. Students can explain the meaning of a circle, differentiate the elements of a circle, and understand the relationship between radius and diameter. 2. Students can calculate the radius, diameter, circumference, and area of a circle. 3. Students can use the formulas for the circumference and area of a circle to solve story problems or contextual problems related to circles.	1. Students can describe the meaning of a circle, differentiate the elements of a circle, and understand the relationship between radius and diameter. 2. Students can determine the circumference and area of a circle. 3. Students can solve problems related to the circumference and area of circles in everyday life.

The development stage involved designing an interactive product draft in the form of an animation video based on Higher Order Thinking Skills (HOTS) and ethnomathematics. The analysis of learning outcomes and learning objectives was then translated into learning video content. After the development process, a feasibility test was conducted with the assistance of material, media, and language experts. The material validator was Dr. Eka Zuliana, M.Pd., who assessed several aspects including learning tools, learning outcomes, learning objectives, instructions, worksheets, practice questions, evaluation questions, answer keys, and scoring guidelines. The results of the material validation indicated that the developed media met the validity criteria and was suitable for use with minor revisions. The media validation was conducted by Dr. Nur Fajrie, M.Pd., who evaluated the technical, instructional, and media display aspects. The results showed that the animation video media was categorized as valid and appropriate to support the learning process. Meanwhile, the language validation was conducted by Dr. Irfai Fathurohman, M.Pd., who assessed writing, communication, and the suitability of language for students' development.

The results of the language validation also indicated that the media was valid and appropriate for use in learning. In addition to providing validation scores, the experts also offered several constructive suggestions for improvement. The suggestions from the material, media, and language experts are presented in Table 3.

Table 3. Suggestions from expert validators on material, media, and language

Subject Matter Expert	Expert Media	Expert Language
1. Emphasize information important 2. Add a number to the table	Add *soundtrack*	1. Add page number 2. Repair the error in typing

Several suggestions from material experts, media experts, and language experts were used by researchers to improve this student worksheet so that it is easier for students to use and understand.

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A limited-scale trial was conducted in Class VI of MI Mansyaul Ulum as the test object. During the small-scale trial, observations were conducted to identify the advantages and disadvantages. Students' reactions to the interactive animation video media were implemented through a questionnaire. The aspects assessed in the initial field test were as follows: 1) instructional media; 2) materials; and 3) technical aspects. Then, students and teachers completed a response questionnaire to assess the product's feasibility. The results of the recapitulation of the student response questionnaire can be seen in Table 4

Table 4. Results of the student response questionnaire recapitulation

No	Aspect	Average	Criteria
1	Quality instructional	3.74	Very practical
2	Quality material	3.82	Very practical
3	Quality technical	3.74	Very practical

Student response questionnaire regarding interactive HOTS and ethomatematics-based animation video media received an average score of 3.76, categorized as very feasible. The feasibility assessment based on the student response questionnaire consisted of three aspects: instructional quality, material quality, and technical quality. The instructional quality aspect obtained an average score of 3.74, categorized as very feasible, followed by the material quality aspect with an average score of 3.82, categorized as very feasible, and finally, the technical quality aspect obtained an average score of 3.74, categorized as very feasible. Based on data obtained from student responses in the main field trial, interactive HOTS-based animation video media and ethomathematics achieved the criteria of being very suitable for use and were ready to be tested in the operational field test phase. Students provided suggestions in the form of adding decorations or markers to the main material. The results of the recapitulation of the teacher response questionnaire can be seen in Table 5.

Table 5. Results of the summary of the teacher response questionnaire

No	Aspect	Average	Criteria
1	Quality instructional	3.88	Very practical
2	Quality material	3.60	Very practical
3	Quality technical	3.42	Very practical

In a limited field trial involving 1 sixth-grade teacher to provide teacher responses to video media. Based on the results of teacher responses to video media received an average score of 3.57 with very appropriate criteria. The assessment of suitability based on teacher response questionnaires consists of three aspects, namely instructional quality, material quality, and technical quality. In the instructional quality aspect, the average score was 3.75 with a very appropriate category; then the material quality aspect obtained an average score of 3.60 with a very appropriate category, and finally, the technical quality obtained an average score of 3.42 with a very appropriate

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category. Based on data obtained from teacher responses in a limited field trial, the video media obtained criteria very appropriate to use. Teachers responded that, in addition to making it easier for students to understand the material, this media was also able to foster a love for regional culture.

d. Implementation

A large-scale trial was conducted in grade VI of Bustanul Ulum Islamic Elementary School as the experimental class and grade VI of Thoriqotul Ulum Islamic Elementary School as the control class. This activity aimed to test the effectiveness of interactive learning. Animation video media based on HOTS and ethomatematics. The control class is a class that does not give the treatment of using video media, but instead uses a student handbook. The experimental class is a class that is given the treatment of using interactive media. Animation video media based on HOTS and ethomatematics.

In both the control and experimental classes, all students completed critical thinking ability tests that had previously been tested for validity, reliability, discrimination, and difficulty. The test questions in both the control and experimental classes were analyzed using SPSS to obtain valid questions. In addition, the questions were also tested for validity by expert observers. Judgment to two experts, namely Dr. Ratri Rahayu, M.Pd, and Dr. Himmatul Ulya, M.Pd. In a large-scale test.

1) Prerequisite Test

(a)Normality Test

The results of the normality test were examined based on the Asymp. Sig. (2-tailed) value obtained from the statistical analysis. The calculation showed an Asymp. Sig. (2-tailed) value of 0.156 for students' critical thinking ability scores. Since this value is greater than the significance level of 0.05, the null hypothesis (H_0) was accepted and the alternative hypothesis (H_a) was rejected. Therefore, it can be concluded that the data are normally distributed and meet the assumption required for subsequent parametric statistical analysis.

(b)Homogeneity Test

The results of the homogeneity test calculations can be seen in Table 6.

Table 6. Homogeneity test result

Levene Statistics	**df1**	**df2**	**Sig.**
.010	1	66	.921

Based on Table 6, the homogeneity test shows that the significance value is 0.921, namely, sig > 0.05, meaning that the data variance is homogeneous.

The results of the prerequisite tests for the experimental and control classes produced both samples with normal distribution and homogeneous variance. Next, a test of the effectiveness of learning was carried out, measured using the following statistical test: a one-way test. Sample t-test, independent test, sample t-test, and N-gain test.

2) Testing the Effectiveness of Video Media Development

The effectiveness of video media can be measured by observing 1) the classical mastery of problem-solving skills; 2) the average problem-solving ability results in the control and experimental groups; and 3) the improvement in students' problem-solving abilities as determined by the

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pretest and posttest scores given to students. The following describes the effectiveness test that has been calculated and analyzed.

(a) Classical Completeness Analysis of Critical Thinking Ability

A Sample T-Test was used. This test was used to determine the results of students' critical thinking skills who participated in learning using interactive media. Animation video media based on HOTS and ethomatematics can achieve the learning objective achievement criteria.

Based on the results of the calculations and analysis, it was obtained that the significance value was 0.13, meaning sig > 0.05, so the average value of the experimental class students was more than 70. The results of the one-way test calculation sample t-test, are explained in Table 7.

Table 7. One-sample t-test

	t	df	Sig (2-tailed)
One-sample t-test	2,067	34	0.13

(b) Analysis of the Differences in Critical Thinking Skills between the Control Class and the Experimental Class

Independent test: The sample t-test is used to determine whether there is a difference in the average of two unpaired samples. In this study, the independent test, the sample t-test, aims to determine the average results of critical thinking skills in two groups of students, namely the control group and the experimental group (given treatment in the form of using interactive animation video media based on HOTS and ethomatematics).

Based on the calculation and analysis results, it can be seen that the significance value is 0.00, meaning sig < 0.05, meaning there is a significant difference between the results in the experimental class and the control class. This is shown in Table 8 regarding the results of the independent test calculations. Sample t-test via SPSS software.

Table 8. Independent sample t-test

Output Type	Model	F	Sig	Sig (2-tailed)
Independent sample test	Equal variances assumed	.037	.848	.000

(c) Analysis of Improving Critical Thinking Skills

Based on the results of calculations and analysis, it was found that out of 33 students in the control class, 13 students were in the low category and 20 students were in the medium category, and the average value of the N-Gain test was 0.31 in the medium category. While in the experimental class, the results of the N-Gain test from 35 students showed that 9 students were in the medium category and 26 students were in the high category, and the average value of the N-Gain test of the experimental class was 0.78, with a high category. The following is Table 9 of the results of the N-Gain test in the control class and the experimental class.

Table 9. N-Gain test results

Group	Mark Average	Category
Control Class	0.31	Currently
Experimental Class	0.78	Tall

According to Paramartha et al., (2020), technology-based media is an appropriate learning alternative for students because it can help students

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add information about the concepts learned through systematic learning activities. Through technology-based media utilizing an ethnomathematics approach oriented to HOTS, it is hoped that it can improve students' critical thinking skills. This is in line with Bintoro et al., (2021) opinion that to make learning materials more interesting, video media is linked to the cultural context around them. Research results show that mathematics learning is more interesting and meaningful for students when linked to the surrounding cultural context (Nisa et al., 2023; Ardianti & Wanabuliandari, 2021).

Mathematics is combined with local cultural elements, namely the culture in Pati Regency, by using ethnomathematics so that students can understand the material and gain a more meaningful learning experience (Bintoro et al., 2024). This is reinforced by the findings of previous studies, which stated that digital media based on HOTS and ethnomathematics are more effective than conventional media (Ramadan et al., 2023; Sunzuma & Umbara, 2025). The advantage of this study is creating interactive video media based on HOTS and ethnomathematics that are appropriate to the characteristics and environment around students, especially the culture in Kudus Regency.

The results of this study are supported by the results of research by Febliza, which states that the improvement of students' critical thinking skills in mathematics can be seen from the increase in the average class value and the percentage of classical learning completion using digital-based media (Febliza et al., 2023). In line with that, Zubaedah et.al in their research results that interactive video learning media can improve students' critical thinking skills (Zubaedah et al., 2024).

Based on the results of calculations and analysis, it can be seen that the critical thinking abilities of students who received learning treatment using interactive learning are improved. HOTS-based animation video media and ethnomathematics outperform students who receive instruction without the use of media. This is consistent with Yenti's research, which found that students taught with HOTS-based technology and ethnomathematics demonstrated higher performance than those taught conventionally (Fitriana et al., 2024; Yenti et al., 2022).

Interactive animated video media based on Higher Order Thinking HOTS and ethnomathematics have been proven effective in developing students' critical thinking skills because they combine a high-level cognitive approach, cultural contextualization, and engaging visual-audio presentation. Misrom et al. stated that HOTS-based learning requires students to analyze, evaluate, and create solutions, which are the core of critical thinking (Misrom et al., 2020). Meanwhile, the ethnomathematics approach, according to Nursyahidah et al., provides a relevant cultural context in learning, making it easier for students to relate abstract mathematical concepts to their everyday realities (Nursyahidah et al., 2025). In addition, multimedia-based media, such as interactive animated videos, can maximize visual and verbal information processing, which supports in-depth understanding and active student engagement in critical thinking (Hapsari et al., 2019; Safitri et al., 2021; Huda et al., 2025). Thus, the integration of these three elements creates meaningful learning and stimulates the optimal development of critical thinking skills.

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CONCLUSIONS

The findings indicate that the developed media is valid based on expert evaluations, practical according to teacher and student responses, and effective in improving students' critical thinking skills, as evidenced by significant differences between the experimental and control groups and supported by N-gain results. Therefore, the media is feasible for use in mathematics learning to promote higher-order thinking in a contextual and culturally relevant manner.

However, this study was limited to specific topics and a particular grade level. Future research is recommended to apply the media to different mathematical materials, educational levels, and cultural contexts, as well as to examine its long-term impact and integration with other instructional models to further optimize students' higher-order thinking skills.

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