



Web-Based Mathematics Learning

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Abstract. The research objective is to develop a valid and practical web-based learning multimedia for mathematics in comparison topic. This current research uses ASSURE model which is adopted as a media development model. The ASSURE model consists of 6 stages, including Analyze learners characteristic, State objectives, Select technology, media and material, Utilize technology, media and material, Require learner participation, and Evaluation and revision. The subjects of this research are students of class VII. The research finding indicate that based on data analysis of media expert and material expert, each obtained on average validity score of 3.32 and 3.72. during the test, the useability test and product test are carried out. The result of readability test analysis is 90.71% with very good criteria. Meanwhile, for the result of test, the student responses are 89.46% with the very positive category, while for the media evaluation by the teacher, the overall average score is 3.81, including in the very practical category. In brief, the developed web-based learning multimedia is valid, obtains a positive response from student, and is practical so that it can be used in learning.

Keywords: web-based learning, ASSURE model, mathematics learning

1 Introduction

In the context of education, one of the fields of study that has an important role is mathematics [1]. Mathematics is a science that needs to be studied because it can be used to solve a problem faced in a social context [2]. Mathematics learning is an interactive process between teachers and students that can encourage students to understand mathematical concepts. Learning mathematics is not only to know concepts, but concepts can be used to solve both problems related to mathematics and daily life [3]. Therefore, to be able to instill concepts, students must construct their knowledge by actively participating in learning. The role of teachers is very important so that students are more active and interested in learning mathematics.

The use of learning media is one of the options that can make students more active so that they are able to receive the material provided. However, the reality on the ground did not go as expected. Based on observations and interviews conducted with mathematics teachers at SMP Negeri 1 Suwawa, because of the *Covid-19 pandemic*, teaching and learning activities are carried out offline for those who have been vaccinated and online for those who have not been vaccinated. In situations and conditions like today, teachers are required to be able to use technology-based learning media. However, at

SMP Negeri 1 Suwawa, especially mathematics teachers, have not developed this media to support learning. For offline learning at school, textbooks are still used by the government, while in the classroom teachers only use modules from powerpoint that are *printed out*. This module only contains a summary of the material consisting of formulas and sample questions. In terms of providing materials, teachers only apply lesson methods to make classroom learning more teacher-centered. Students mainly listen to the teacher explain and take notes on the material from the board. Students mostly listen to the teacher's explanation and write the material on the board. As for online learning itself, it is still limited, where the material presented is only sent to the WhatsApp group without any direct interaction with the teacher. This makes the learning process monotonous and makes students uninterested in learning mathematics which results in students' lack of understanding of related materials. Of the several mathematics materials taught, most students do not understand the comparative material.

Based on existing problems, there is a need for media development in learning. Learning media is a good, effective teaching method that follows technological developments. With this technology, teachers can take advantage of innovations in media, namely multimedia. According to [4] Multimedia can be interpreted as a combination of frames, videos, animations and voices in a software that can be directly manipulated by users. With a multimedia display that presents interesting concepts, students will not feel bored during learning. So that the material provided is easier to understand. Multimedia learning that is in accordance with the problems that occur at SMP Negeri 1 Suwawa that utilizes technology is *Web* and *mobile e-learning*. [5] argues that web-based learning media is a device that utilizes internet facilities to deliver material from teachers to students to be accessed anytime, anywhere. In the world of education, the internet can make it easier for teachers to improve the quality of learning by producing various media [6]. Through the use of web-based multimedia, an effective learning process can be created where students can interactively repeat material that has not been understood at any time, thereby increasing student motivation.

Similar research has also been conducted before by [7] and research by [8]. The difference between this study and the previous one is in the material and subject of the research, namely junior high and high school students. The update of this research is the application/software used to develop *Web Using Canva Education*, then the material is a comparison with the research subject is junior high school students.

Based on the description above, it is necessary to conduct research on the development of web-based mathematics learning multimedia on comparative materials in grade VII SMP Negeri 1 Suwawa. The purpose of this research is to develop a valid and practical web-based mathematics learning multimedia.

2 Research Methods

Research *and Development* using a quantitative approach oriented to product development, was carried out in May-June 2022 in grade VII of SMP Negeri 1 Suwawa. To obtain data, interviews, validation sheets and questionnaire distribution were carried out. In this study, the ASSURE model was used developed by Smaldino, et al. which was then adopted as a model for learning media development. The stages in this model

are found in the name of the model itself, namely ASSURE. The stages of the ASSURE model are as follows:

The first stage is *Analyze learners characteristic*, some of the activities carried out during this stage are analysis of general characteristics to find out the socio-cultural background of students, age and level of cognitive development; analysis of students' initial abilities to find out students' ability to understand learning materials, and learning styles. During this stage, researchers interview math teachers and distribute questionnaires to students. The results of this analysis can be used as a basis for the development of appropriate media. The second stage is *State objectives*, where the development goals and learning objectives to be achieved are based on previous analysis. The purpose of the lesson refers to the KI and KD of the material to be developed.

The third *stage is Select technology, media and materials*, at this stage a review of technology, media and materials is carried out in accordance with the results of the analysis and the goals to be achieved. The fourth stage is *Utilize technology, media and materials*, at this stage several activities are carried out such as initial design including: preparation of lesson plans, making instruments, making storyboards. Then multimedia development was carried out which resulted in **Draft I**. This stage is also validated by providing a validation sheet which is then analyzed using a 0 – 4 likert scale. The formula used is as follows:

$$SR = \frac{\sum_{i=1}^n X_i}{m} \tag{1}$$

$$SRK = \frac{jumlah\ SR}{banyak\ aspek} \tag{2}$$

with

SR = Average score

Xi = Identical validator score

m = Number of validators

SRK = Overall average score

Furthermore, the score is converted into a qualitative value as shown in Table 1 below: Source: [9]

Table 1. Validation success criteria.

Score Interval	Criterion
Average validation results > 3.40	Highly Valid
2.80 < Average validation results ≤ 3.40	Valid
2.20 < Average validation results ≤ 2.80	Quite Valid
1.60 < Average validation results ≤ 2.20	Less Valid
Average validation results ≤ 1.60	Invalid

In addition to validation, at this stage a revision was also carried out that resulted in **Draft II**. The fifth stage *is Require learner participation*, at this stage a readability test

of **Draft II** is carried out to find out whether the learning multimedia can be read and understood by students. The readability test was carried out to 6 students of SMP Negeri 1 Suwawa, then students filled out a readability sheet containing questions that would be suggestions for improvement of the product so that they would produce **Draft III**. Previously, the readability test questionnaire was analyzed using a *Likert* scale interval 0 – 4 with the following formula [10]:

$$PR = \left(\frac{\sum \text{Response score for each aspect}}{\text{Maximum score}} \right) \times 100\% \tag{3}$$

With the percentage of the assessment scale as shown in Table 2 below: Product

Table 2. Score Interpretation Criteria.

Percentage	Interpretation
0% - 20%	Very Not Good
21% - 40%	Bad
41% - 60%	Pretty Good
61% - 80%	Good
81% - 100%	Excellent

testing is also carried out at this stage. The media will be tested on 38 students and the media evaluation by the teacher, then the students fill out a student response questionnaire and the teacher fills out the media evaluation questionnaire. The sixth stage is **Evaluation and revise**. This stage aims to assess and revise products that have been tested. In the evaluation process, it is used to evaluate the results of testing products that have been developed. The data analyzed were student response sheets and media evaluations by teachers, each of which used the following formula:

$$Ri = \frac{\sum_{j=1}^n Pj}{\text{Maximum score of aspect } i - j} \tag{4}$$

with

Ri= Percentage of i-aspect response

Pj = Score of the jth respondent

n = Number of respondents

Then calculate the average of the total percentages:

$$RT = \frac{\sum_{i=1}^m Ri}{m}$$

with m = Many aspects.

The scores obtained are then converted in Table 3.

The student’s response is said to be positive if the student gives a response of 70% or more with a minimum positive category for each aspect.

Table 3. Categories Student Response.

Score Interval	Category
$85\% \leq RT$	Very positive
$70\% \leq RT < 85\%$	Positive
$50\% \leq RT < 70\%$	Less positive
$RT < 50\%$	Not positive

Source: Modified from [9]

The media evaluation formula used by teachers is as follows:

$$\text{Averagescore} = \frac{\text{total score}}{\text{number of grains}} \tag{5}$$

$$\text{SRK} = \frac{\text{sum of total score}}{\text{number of aspect}} \tag{6}$$

Existing scores are converted to

Table 4. Criteria for the Practicality of Learning Media.

Score Interval	Criterion
Average practicality result 3.40	Very practical
2.80 Average results of practicality 3.40	Practical
2.20 Average practical results i 2.80	Quite practical
1.60 Average results of practicality 2.20	Less practical
Average practicality result 1.60	Impractical

Source: Widoyoko in [9]

In the revision stage, it is used to correct the shortcomings that existed in the previous stage. The result of this revision will be the **Final Draft**.

3 Results and Discussion

This study produced web-based learning multimedia on comparative materials with the ASSURE development model. The results and discussion of each stage are as follows.

Tahap Analyze learners characteristic

At this stage, the researcher analyzes the characteristics of the students. The students who were the research sample were Class VII, 10 boys and 18 girls, with a total of 28 people. Students come from a variety of backgrounds and financial circumstances. Most of the students' parents work as farmers, but some are civil servants, police and soldiers. Grade 7 students of SMP Negeri 1 Suwawa are around 13-14 years old. According

to Piaget's theory, the cognitive development of children over the age of 11 is at a formal operational stage. Where students have the ability to think abstractly. The school environment and student residences are not far away and are still in areas that can be reached by the signal. In learning, there is no web-based media because they think that web creation is still difficult, there must be a syntax.

Based on interviews with mathematics teachers, information was obtained that students' initial abilities were still low. With the *Covid-19* pandemic, it is difficult for students to absorb the materials provided. They are still weak in operating numbers. From the learning style questionnaire, it was also found that students had different learning styles, including 12 visual, 10 auditory and 6 kinesthetic. Based on this analysis, the researcher provides a solution, namely developing learning media by accommodating visual, auditory and kinesthetic learning styles. For visual learning styles, media is created that contains text and images or animations that can be seen directly by students. For auditory learning styles, media is made that contains learning sounds and videos that can be heard by students, while for the kinesthetic learning style, the learning method is by practicing it directly, the media developed can be used directly by students without having to listen to the teacher's explanation.

Tahap State Objectives


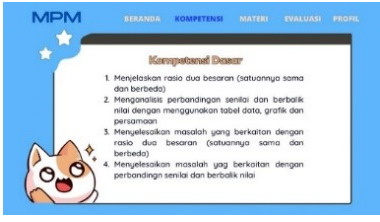


At this stage, the researcher identifies learning objectives and development objectives as specifically as possible. The learning objectives used are that after using web-based learning media, students are expected to be able to:

1. Be able to correctly determine and solve problems related to the comparison of two quantities (equal and different)
2. Can analyze value comparisons and reverse values
3. Can distinguish between value comparison and inverted value problems (with tables, graphs and equations)

According to [11] Learning objectives are designed to realize knowledge in the hope that students can master it. So, The purpose of the development of this media is to create a learning multimedia for students to repeat the material given, students can learn anytime and anywhere so that they can better understand the material.

Tahap Select Technology, Media and Materials At this stage, the selection of technology, media and materials is carried out. Media that is suitable for use according to the characteristics of students and the goal of development is multimedia-based learning *Web*. According to [12] Based learning media *Web* is a medium that is not limited spatially and temporally by using internet technology. So that researchers choose internet-based technology in the form of applications *Canva Education*, *Quizizz*, YouTube and Bit.ly. The reason for choosing the technology is because it is easy to access and does not require coding so that it is suitable for teachers to use in developing learning media based on *Web*. *Canva Education* used as the main application in developing *Web*. *Canva Education* offers various advantages such as easy access, attractive appearance and comfortable to use [13]. *Quizizz* used in providing evaluations. With the existence of *quizizz* Students will be more enthusiastic in working on matematika questions because this technology is in the form of an educational game that displays questions with a

Table 5. Draft Result 1.

Display	Information
<p style="text-align: center;">Porch</p> 	<p style="text-align: center;">Home</p> <p>This page is the initial view of the <i>web</i>. In this section, it displays headers (website logo, home menu, competency menu, material menu, evaluation menu, profile menu), welcome greeting, material title, and animation that makes the <i>web appearance</i> more attractive.</p>
<p style="text-align: center;">Competence</p> 	<p>In this section, it displays the basic competencies that will be achieved by students</p>
<p style="text-align: center;">Material</p> 	<p>This section displays instructions for accessing the provided sub-material that students will learn</p>
<p style="text-align: center;">Evaluation</p> 	<p>This section displays instructions for accessing the evaluations that will be integrated with Quizizz as practice to students after learning the material</p>

limited time so that it can trigger student motivation. Moreover *Quizizz* also has accompaniment music when students work on problems. This is in accordance with the views expressed (Bosnia, 2020) that students will feel happy, comfortable and motivated to do the evaluation with the *Quizizz* which vary. YouTube is used as a technology that will clarify material containing sample questions in the form of videos. According to [14]

Table 5. Draft Result 1.(Continued)

Display

Information

Profile

This section features profiles of developers, researchers, and mentors



Sub Material Page

Comparing Two Quantities

This section displays illustrations of comparison, the concept of comparison, the meaning of comparison of two equal and different quantities and an in-depth study of example questions in the form of videos



This section displays material on the meaning of value comparison, how to calculate value comparison, formulas and deepening of example questions in the form of videos

Value Comparison



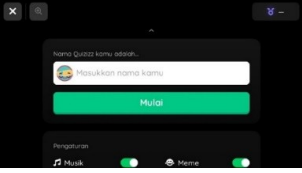


Value Reversal Comparison

This section displays material on the meaning of value reversal comparison, formulas and deepening videos of example questions



YouTube is one of the internet-based video technologies that allows it to be accessed *online* and *offline* So that students can continue their studies anytime, anytime. *Bit.Ly* used to shorten addresses *Web*. The researcher also used several media provided by the school in carrying out the learning process and selected comparison materials with sub-materials comparing two quantities, equivalent comparisons and reversal comparisons.

Table 5. Draft Result 1.(Continued)

Display	Information
<p data-bbox="276 291 335 317">login</p> 	<p data-bbox="488 246 658 273">Evaluation Page</p> <p data-bbox="499 296 1037 352">In this section, it displays a name column that students can fill in when they are going to do the evaluation</p>
<p data-bbox="252 520 346 546">Question</p> 	<p data-bbox="499 525 1037 582">This section displays the questions that students will do. The question consists of 10 questions</p>
<p data-bbox="211 744 393 770">Score Acquisition</p> 	<p data-bbox="499 749 1037 806">This section displays the scores obtained by students after doing the evaluation</p>

Tahap Utilize Technology, Media and Materials

At this stage, the initial design of multimedia development was carried out to make lesson plans, instruments and storyboards. After the initial design is completed, it is continued with the development of multimedia called **Draft I** which can be seen in Table 5.

After **Draft I** was completed, 6 verifiers (namely, 3 lecturers from Gorontalo State University and 3 junior high school mathematics teachers) consisting of media experts and material experts validated the learning multimedia by providing validation sheets, then analyzed, as seen in Table 6.

Table 6. Media Expert Validation Results.

Assessment Aspects	Average Score	Criterion
<i>Usability</i>	3.17	Valid
<i>Functionality</i>	3.47	Highly Valid
<i>Visual Communication</i>	3.33	Highly Valid
Overall Average Score	3.32	Valid

Table 7. Media Revision Results

Before Revision (Draft I)



The layout of the material is made in the form of buttons, preferably white and not transparent and the writing uses dark colors to make it more embossed and attractive

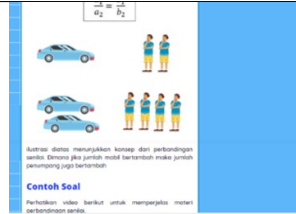
After Revision (Draft II)



The layout of the material is readable and attractive



In the explanation of the material, illustrations or animations can be added in addition to the video at the end



Explanation of the material has been added illustrations

The average score of the validation results of media experts is 3.32, which means that the media developed is valid. However, at the time of verification, validators also provide comments and suggestions to the media. The suggestions given are to add animations or illustrations to the material, improve the layout and shorten the URL to make it easier to remember. The following recommendations from media expert validators are shown in **Table 7**.

The validation of the subject matter expert is also analyzed like the previous expert. The results of the validation of the subject matter experts can be seen in **Table 8**.

The average overall score of the validation of the subject matter expert obtained 3.72 which means that the material in the media is valid. Similar to the validation of media experts, for the validation of material experts, validators also provide comments and suggestions that have then been improved. The following recommendations from the material expert validators are shown in **Table 9**.

Tahap Require Learner Participation

At this stage, a readability test was held for 6 grade VII students of SMP Negeri 1 Suwawa. After Draft II is said to be valid, then the researcher conducts a media readability test. At this stage, the researcher teaches how to use media to students and then distributes a readability test questionnaire. The results of the readability test are shown in **Table 10**. The average score of the overall percentage of the readability test was 90.71%, which means that the media developed can be read so that it can be tested. The results of this readability test are named Draft III. In the readability test, students

Table 7. Media Revision Results (Continued)


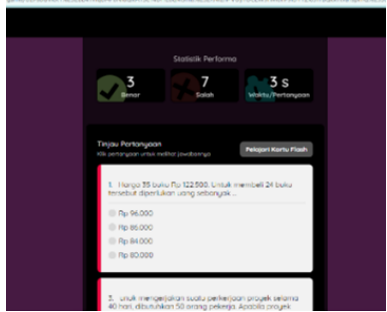


Before Revision (Draft I)	After Revision (Draft II)
 <p>The answer to the question should be presented at the end</p>	 <p>The answer to the question has been corrected as suggested</p>
 <p>The web address is changed in the Bit.ly to make it short and memorable (http://media-12.my.canva.site/perbandingan-kelas-vii-smp-mts-sederjat)</p>	 <p>The web address has been changed to https://Bit.ly/matematika-perbandingan</p>

Table 8. Material Expert Validation Results.

Assessment Aspects	Average Score	Criterion
Content Quality	3.75	Highly Valid
Pedagogical Didacticist	3.02	Highly Valid
Interaction	3.75	Highly Valid
Display/Layout	3.75	Highly Valid
Overall Average Score	3.72	Highly Valid

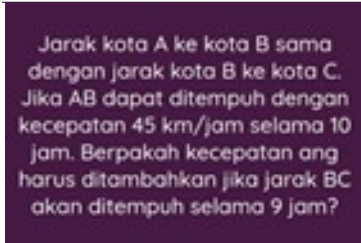
give suggestions to add duration to the questions. The suggestions and the results of the revision can be seen in **Table 11**.

After Draft III can be read and understood by students, then a trial is carried out in class VIIC. The researcher teaches using learning knowledge to pay attention to and try media through their respective computers and smartphones . After testing the product, the researcher provided a Student Response Questionnaire to find out how students responded to the use of media, and a Teacher Media Assessment Questionnaire to find out the teacher’s assessment of the practicality of multimedia learning. Evaluation and revise stage At this stage, the researcher analyzes the student response sheet and media evaluation by the teacher during the trial and makes the final revision. The results of the analysis of student responses can be shown in Table 12.

The student response was 89.46, which means that the media developed received a positive response from students. The results of the media evaluation by teachers can be presented in **Table 12**. The average overall score of media evaluation by teachers was 3.81, which means that the media developed is practical. Based on the students’ re-

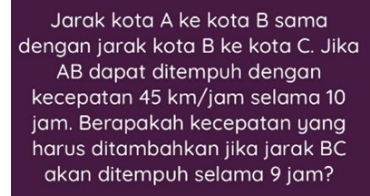
Table 9. Media Revision Results

Before Revision (Draft I)

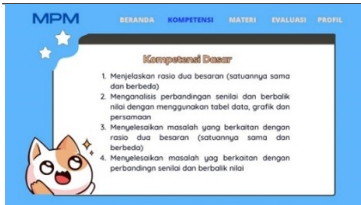


Fix question no 3 there is a writing error

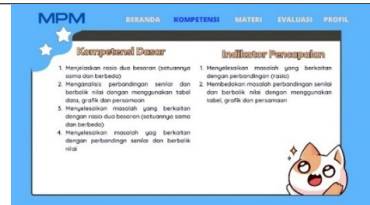
After Revision (Draft II)



Writing errors in questions have been fixed



Equip with achievement indicators



Achievement indicators have been added



Add example questions to a value reversal comparison in addition to video



Sample questions have been added

sponses and media evaluations by the teachers, the Final Draft was obtained which can be accessed through <http://Bit.ly/matematika-perbandingan>. The media developed produces multimedia mathematics learning based on Web valid and practical comparative material. Multimedia based mathematics learning Web It contains materials, sample questions, learning videos, interesting animations and evaluations. This refers to research conducted by [8] about the content of the material of the product consisting of several models, but the difference with this research is that the technology used and replacing the LKS with Quizizz. This research and development has two objectives. The purpose of this study is to determine the validity and practicality of web-based learning multimedia in comparative materials for junior high school students. From Tables

Table 10. Material Expert Validation Results.

It	Assessment Aspects	Percentage Each Aspect	of Criterion
1	The text or writing on this web learning multi-media is easy to read	100%	Excellent
2	Images displayed in the web are clear or not blurry	100%	Excellent
3	The images displayed in the multimedia web learning are interesting	95,83%	Excellent
4	The images shown are in accordance with the comparison material	83,33%	Excellent
5	The material presented in this learning multi-media helped me and my friends in discussing	87,5%	Excellent
6	The material can be easily understood step by step	95,8%	Excellent
7	The material presented has collapsed	79,17%	Good
8	There are no double meaning phrases on this web	79,2%	Good
9	I can understand the material in this learning multimedia	95,83%	Excellent
10	The web is easy to operate	95,83%	Excellent
11	This web-based learning multimedia makes learning easier for me	87,5%	Excellent
12	I am very interested in using this web	91,67%	Excellent
13	I am more interested in learning mathematics by using web-based learning multimedia	87,5%	Excellent
Overall Percentage Average Score		90.71	Excellent

6 and 8, it can be seen that the validation of multimedia media experts based on web learning has an average overall score of 3.32, in the interval of 2.8-3.4 valid categories, while the validation of the evaluation of material experts obtained 3.72, namely in the interval ζ 3.40, the standard is very valid, meaning that the media developed is worthy of testing. The media quality scored an average of 3.75 on a very practical scale. With an average score of 3.67 reviewed from the quality of learning, with very valid criteria. So the average result of the teacher’s media evaluation as a whole is 3.81 which is a very practical category.

4 Conclusion

Based on the results of the research and discussion, as well as after assessing media experts and material experts, a common thread can be drawn that this learning multimedia can be said to be valid, and the average survival score is 3.32 and 3.72, respectively. Web-based multimedia learning is also said to be practical, as shown by the results of media evaluation by teachers, obtaining an overall average score of 3.81 which is included in the very practical category. In this case, it appears that the web-based learning multimedia developed can be used for learning.

Table 11. Material Expert Validation Results.

It	Assessment Aspects	Percentage Each Aspect	of Criterion
1.	I feel happy to take part in comparative learning	94,64 %	Very Positive
2.	I enjoy following the learning that has the media	91,96 %	Very Positive
3.	With the existence of these learning media, it makes me feel that I am not bored participating in learning	88,39 %	Very Positive
4.	<i>This web</i> is interesting to me, so I become even more excited about learning comparative materials	84,82 %	Positive
5.	I'm interested in the video on the <i>web</i>	87,5 %	Very Positive
6.	I was able to use this <i>web</i> well	86,61 %	Very Positive
7.	I understand the language used in <i>this web</i>	82,29 %	Positive
8.	I can focus on the comparative material taught with this learning multimedia	89,29 %	Very Positive
9.	With the existence of multimedia learning, I can learn comparative material anywhere and anytime	91,07 %	Very Positive
10.	<i>This web look</i> is very attractive	91,07 %	Very Positive
Average percentage of total		89.46	Very Positive

Table 12. Results of Media Evaluation by Teachers.

No.	Assessment Aspects	Average Score	Criterion
1.	<i>Quality Of Content and Purpose</i>	4	Very practical
2.	<i>Media Quality</i>	3.75	Very practical
3.	<i>Quality of Learning</i>	3.67	Very practical
Overall Average Score		3.81	Very practical

Based on the conclusion above, recommendations can be given to researchers who will conduct research related to this research should use quality Canva education so that the features are more attractive. Based on the results of the research, students responded positively to web-based learning multimedia, so it is necessary to develop additional media materials. Based on the research conducted by the researcher, the researcher did not measure the effectiveness of the media, so the next researcher if he wants to develop existing media, the researcher suggests increasing the effectiveness of the media.

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