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The Effectiveness of Kebatar Media (Kendang Bangun Datar) Based on Local Wisdom of Reog Kendang Tulungagung to Improve Critical Thinking Skills of Elementary School Students

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ABSTRACT

This study was motivated by the lack of utilization of varied and interactive mathematics learning media, resulting in ineffective and boring learning, as well as low critical thinking skills. Therefore, innovative media is needed to make learning more interesting and easier to understand. This study aims to determine the effectiveness of developing Kebatar media based on the local wisdom of Reog Kendang Tulungagung. This study uses the ADDIE model, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation. The results of the study show that the media experts rated the criteria as 97% highly valid, while the subject matter experts rated the criteria as 94% highly valid. The practicality of the product was assessed based on student responses through a questionnaire, with 92% of the criteria rated as highly practical. The effectiveness of the product was demonstrated through an increase in students' critical thinking skills, with an N-Gain score of 0.71, which falls into the high category. Therefore, the development of Kebatar media assisted by QR codes based on the local wisdom of Reog Kendang Tulungagung is deemed valid, practical, and effective for use as a learning medium for flat shape material to enhance students' critical thinking skills.

1. INTRODUCTION

Mathematics is one of the subjects that must be learned from an early age, which involves various calculations that are logical, precise, systematic, and accurate [1]. Mathematics is defined as the science related to logic, form, structure, magnitude, and interconnected concepts[2],[3]. Mathematics encompasses various branches such as arithmetic, algebra, geometry, and analysis [4]. Some students perceive mathematics as a daunting subject with boring numbers, leading to difficulties and a lack of interest in learning mathematics [3]. Students face difficulties in understanding mathematical concepts as evidenced by the high number of students receiving low grades on assignments and daily quizzes[5]. One of the causes of low learning outcomes is the monotonous methods and media used in mathematics education at the elementary school level [6]such as the use of lectures, assignments, and the lack of

learning media, which make students feel bored and less interested in learning[7]. Teachers need to make various efforts to help students better understand the learning material [8]. Based on the results of the needs analysis conducted at the elementary school, no concrete or audiovisual media were found, particularly for the subject of Mathematics, specifically the topic of two-dimensional shapes [9]. The available media are limited to wall-mounted images and three-dimensional shapes. Specifically for the topic of two-dimensional shapes, no media were found that are appropriate and capable of accelerating the absorption of material or the transmission of information from teacher to student. However, the role of media is very important in learning, especially for mathematics [10]. Nevertheless, there are several reog Tulungagung-style musical instruments neatly arranged on the classroom shelf.

These kendang instruments appear neglected, yet upon closer inspection, the decorations on the Tulungagung reog kendang instruments feature distinctive patterns of various two-dimensional shapes. Given this fact, the researcher attempted to utilize, modify, and develop these kendang instruments to serve as educational media [11]. One suitable medium to apply at the concrete operational stage is a combination of concrete and abstract media [12]. Digital media can be audiovisual-based. Learning is 25% easier to understand with audio media, 45% with visual media, and 80% with tactile and audiovisual media[13]. Audiovisual media is technology-based media that can be combined with other technology-based media, namely QR codes [14]. QR Codes are one of the advancements in technology that can be utilized in the field of education [15]. This QR Code media is a two-dimensional image that can display data in text form, thereby serving as an interactive tool between teachers and students in transferring knowledge and information [15]. Three-dimensional concrete media equipped with QR Codes are expected to become a modern learning tool capable of presenting contextual explanations about two-dimensional shapes in an easy-to-understand manner and keeping pace with the times [16]. The use of two-dimensional shape media is expected to enhance students' critical thinking skills. Critical thinking is based on updating knowledge, analyzing differences, observing cause and effect, and generating new ideas [17]. Critical thinking trains one to think logically and not accept things easily. Critical thinking is a higher-order thinking skill that needs to be developed in learning to achieve effective results [18]. Critical thinking is based on updating knowledge, analyzing differences, observing cause and effect, and generating new ideas[8], [19]. Students must possess critical thinking skills. Failing to use critical thinking skills can result in students becoming inactive and unresponsive to problem-solving, clarification, and drawing conclusions [20].

State-of-the-art and novelty in previous research conducted by [12],[21] was limited to discussing ethnomathematics in elementary schools, whereas this study provides specific tricks and tips for mathematics learning by integrating the wisdom of reog kendang in Tulungagung so as to improve students' critical thinking skills. Additionally, previous research by [22] discussed the use of technology-based media in learning, whereas this study integrates local culture with technology so that students can gain a deeper understanding of local wisdom and the application of technology.

2. METHOD

Research Procedures

The type of research used, Research and Development (R&D), is a type of research aimed at producing effective products, which is in line with the opinion [13]that the purpose of development research is “not to test or formulate theories, but to develop effective products for use in schools.” The research and development procedure uses the ADDIE model developed by Robert Maribe Branch [23]which consists of five stages (Analysis, Design, Development, Implementation, and Evaluation), as illustrated below on Figure 1.

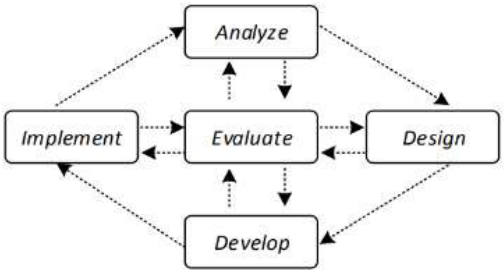

Figure 1. The Development Procedure Followed The ADDIE Model

The pilot design used a small-scale test involving six students and a large-scale test involving 21 elementary school students in Tulungagung.

Research Instruments

The instruments used were interviews, questionnaires, and critical thinking skills questions. The questionnaire was selected by the researcher to determine the responses of media experts, subject matter experts, teachers, and students toward the media. Critical thinking skill questions were used to measure students' critical thinking skills based on indicators [24], including: the ability to observe, ask questions, analyze, explain, and draw conclusions. The data used in this study were qualitative and quantitative. Qualitative data were obtained from interviews and questionnaires. The following is the research instrument grid in Table 1 and Table 2.

Table 1. The Validation Instrument Grid For Media Experts

No.	Indicator	Sub Indicator	No. Item
1.	Display	Color	1,2
		Media size	3
		Flat shape type	4
		Audio clarity	5,6
2.	Ease of use	Easy to operate	7
		Easy to store	8
		Easy to apply	9
3.	Consistency	Consistency of location	10
		Psotove impact and attractiveness	11,12,13
4.	Usefulness	Ease of teaching and learning activities	14,15
		Ease of delivering material	16

Table 2. The Validation Instrument Grid For Material Experts

No.	Aspect	Indicator	No. Item
1.	Material quality	Accuracy of content or concept of material	1,2
		Appropriateness of material to objectives	3
		Accuracy of competencies	4
		Accuracy of material	5
		Completeness of material	6
		Sequence of material	7

		Level of difficulty and depth of material	8
		Appropriateness of task to objectives	9
		Appropriateness to student characteristics	10
2.	Usefulness	Assists the learning process	11
		Facilitates student understanding	12
		Attracts student attention	13,14,15

Data Alysis Techniques

Data analysis techniques use qualitative and quantitative methods. Qualitative data analysis techniques are used to process data in the form of suggestions and input. Quantitative data analysis techniques are obtained from data collected from expert validation questionnaires and critical thinking skills using the following scoring criteria. The formula is as follows with the Equation (1) and Table 3.

$$\text{Validity percentage} = \frac{total\ validation\ score}{maximum\ score} \quad (1)$$

Table 3. The Criteria For Media Product Validity

No.	Value interval	criteria
1	0%-25%	Not valid
2	26%-50%	Sufficiently valid
3	51%-75%	Valid
4	76%-100%	Highly valid

Practicality analysis was conducted by compiling data from user response questionnaires on learning media, then determining the average total score of the questionnaire responses and converting the average score into a percentage. Student response data was obtained from questionnaires given to students. The formula is as follows with the Equation (2) and Table 4.

$$Practicality\ percentage = \frac{total\ score\ obtained}{maximum\ score} x100\% \quad (2)$$

Table 4. The Criteria For Product Practicality

No.	Value interval	Criteria
1	0%-25%	Not practical
2	26%-50%	Quite practical
3	51%-75%	Practical
4	76%-100%	Very practical

The effectiveness analysis can be seen from the critical thinking skills test questions given before and after the learning process. Students' abilities are measured using the N-Gain (Normality Gain) formula. The formula is as follows with the Equation (3) and Table 5.

$$N - gain \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score} \quad (3)$$

Table 5. The Criteria For Product Effectiveness

Criteria	Value
High	0,70<g<1,00
Medium	0,30<g<0,70

Low	g<0,30

Source **:** [25]

3. RESULTS AND DISCUSSION

RESULTS

3.1 Analysis stage

The analysis stage began with analyzing the needs of teachers and students. The interviews revealed that students preferred learning using learning media, but teachers did not have the time to create a variety of learning media due to limited time and energy. Thus, it can be said that students need a variety of media, while teachers are not yet optimal in providing or supplying learning media. Teachers also stated that the media most needed is mathematics teaching media. This is because mathematics is a challenging subject for second-grade students, so teachers are required to provide more detailed and thorough explanations. Based on the analysis results, the researcher proposed a solution by utilizing existing facilities and infrastructure to develop KEBATAR media.

3.2 Design stage

The design process in the development of Kebatar media begins with creating a storyboard, which is illustrated as follows in figure 2.

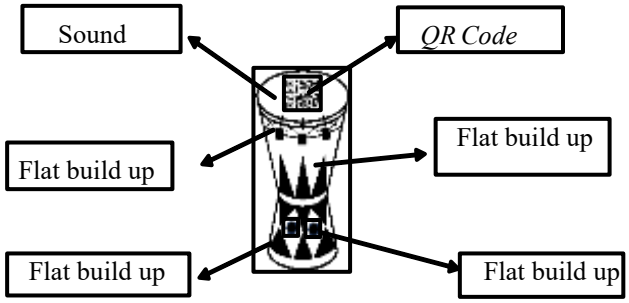

Figure 2. The Storyboard Design Of The Kebatar Media

From the image above, it can be seen that at the top there is a QR code containing a video lesson about flat shapes and an introduction to the local wisdom of Reog Kendang Tulungagung. Inside the drum there is a sound used for ice breaking, containing songs about flat shapes. On the frame of the drum, there are various types of flat shapes that can be assembled and disassembled, such as triangles, circles, and semicircles, which are useful for student activities like arranging flat shapes.

3.3 Development stage

The steps taken during the development stage are described as follows. The original Tulungagung kendang is not a replica or toy, but a genuine kendang with a loud sound, high-quality wood, selected drum skins, distinctive local artistic carvings, and manual craftsmanship by traditional artisans from Tulungagung. The carvings on the Kebatar media are shown in Figure 3.

Figure 3. The Carvings On The Kebatar Media

Carving kendang on KEBATAR media is adjusted to the context of the material to be taught, which is about flat shapes. Carving flat shapes on KEBATAR media includes triangles and semicircles. This is done without damaging the original pattern or shape of the kendang. However, existing shapes are carved according to development needs. The tool used for carving the KEBATAR medium is called a carving chisel. Types of carving chisels include angled chisels, nail chisels, groove chisels, and straight chisels. The painting and clear cloat gloss process of the media is depicted in Figure 4 and Figure 5.

Figure 4. The Painting Process

Figure 5. Clear Cloat Gloss

Painting the media aims to restore the color composition so that it remains attractive and true to the original. The painting process is carried out in two stages: the first stage is the base coat, and the second stage is the finishing coat. The base coat is applied using a neutral color or white paint. Once it is completely dry, the second stage is carried out using glossy paint. The image above shows the result of the finishing coat or Clear Coat Gloss. This makes the KEBATAR medium appear smooth and glossy, thereby enhancing the appeal of the medium. The audio component of the Kebatar media is presented in Figure 6.

Figure 6. The Audio Component Of The Kebatar Media

In the audio production stage, the researchers relied on electrical professionals. This was due to the researchers' limited knowledge of electrical and audio equipment. The audio produces the desired sound. It does not use cables but instead uses ACCU to minimize danger and ensure safe use.Once the audio circuit is complete, the next step is to attach the audio circuit to the inside of the drum. The attachment is done using glue, and holes and buttons are made to produce the audio. The final product of the Kebatar media is displayed in Figure 7.

Figure 7. The Final Product of The Kebatar Media

KEBATAR media is media that is tailored to the needs of students. The media is designed in such a way as to achieve maximum results. KEBATAR Media helps students understand the concept of two-dimensional shapes and contributes to preserving the local wisdom of Tulungagung, specifically the art of Reog Kendang. KEBATAR Media simplifies teachers' delivery of lessons because it is a concrete medium that allows students to interact directly with it. The media is designed to be safe to use without electricity, thereby maximizing learning without exposing students to potential hazards or negative influences.

Next, the media that had been validated by subject matter experts and media experts. Media expert validation aims to assess the quality of appearance, ease of use, color composition, and suitability of the media to the characteristics of elementary school students. The media experts involved in this study were two academics in the field of educational technology. Based on the results of the assessment by the media expert validators, the results are described as follows the Table 6.

Table 6. The Results of Media Expert Validation

No.	Aspects assessed	Validator 1	Validator 2
1.	Regular color composition	4	4
2.	Color selection according to the characteristics of elementary school students	4	4
3.	Appropriateness of flat shape size	4	4
4.	Appropriateness of flat shape selection in kebatar media	3	4
5.	Clarity of audio or sound	3	3
6.	Balance of sound volume	4	4
7.	Kebatar media can be used and accessed easily	4	4
8.	Kebatar media is easy to store	4	4
9.	Kebatar media is easy to use	4	4
10.	The flat carning display on Kebatar media is consistent/regular	4	4
11.	Kebatar media fosters critical thingking skills in students	4	4
12.	Kebatar media facilitates students in learning activities	4	4

13.	Kebatar media facilitates teachers in learning activities	4	4
14.	Kebatar Media is comprehensive, tailored to needs, and facilitates student	3	4
15.	Kebatar media helps students understand lessons more easily	4	4
16.	Kebatar media facilitates teachers in teaching mathematics and art	4	4
	Total score	**61**	**63**
	Total value	**95**	**98**
	Average score	**97**	
	Criteria	**Sangat valid**	

Based on the table above, the average score of both validators obtained a total average score of 193 with a validity percentage of 97%. If converted according to quantitative descriptive statistical guidelines, the development of Kebatar media falls into the highly valid category and can therefore be used as one of the learning media for elementary school students.

Expert content validation focuses on the content or substance of the learning material. This validation aims to ensure that the developed material aligns with the current curriculum, is relevant to the subject matter, and is appropriate for the cognitive development level of the students. The expert content validators involved in this study were practitioners in the field of Mathematics education. Based on the evaluation results by the expert content validators, the findings are summarized as follows the Table 7.

Table 7. The Results of Material Expert Validation

No.	Aspects assessted	Validator 1	Validator 2
1.	The concept of flat shapes is in line with CP/ATP	4	4
2.	The concept of flat shapes is in line with CP/ATP	4	3
3.	The material on KEBATAR media is in line with the subject being studied/learning objectives	3	4
4.	Accuracy of material coverage	4	3
5.	Accuracy of logical presentation of material	3	3
6.	Material is presented comprehensively	4	3
7.	Material is presented sequentially	4	4
8.	Material is easy to understand	4	4
9.	Assignments are in line with learning objectives	4	4
10.	The material is explained according to the developmental stage of elementary school students	4	4
11.	The material on KEBATAR media is explained concisely to aid learning	4	4
12.	The material on KEBATAR media is explained clearly	4	3
13.	The material on KEBATAR media makes students want to continue learning	4	4
14.	The material on KEBATAR media makes students focus on learning	4	4
15.	The material on KEBATAR media makes students understand the lessons more quickly	4	4
	Total score	**58**	**55**
	Total value	**96**	**91**
	Average	**94**	

criteria		**Highly valid**

Based on the table above, the average score of both validators obtained a total average score of 187 with a validity percentage of 94%. If converted according to quantitative descriptive statistical guidelines, the development of Kebatar media falls into the highly valid category and can be used as one of the learning media for elementary school students.

3.4 Implementation Stage

The media was implemented for 21 students in grade 2 at SDN 02 Purworejo. The following is a trial of the Kebatar media in the form of a response questionnaire for students. The data from the large group trial are shown in Table 8.

Table 8. The Data from The Large Group Trial

Respondents	**Indicator**										**Score**	**% Practicality**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**		
R 1	4	3	3	4	4	4	3	4	4	4	37	92,5
R 2	4	3	4	4	4	4	3	4	4	3	37	92,5
R 3	4	4	4	4	4	4	4	4	3	3	38	95
R 4	4	4	4	3	3	4	4	4	4	3	37	92,5
R 5	4	4	3	4	4	3	4	4	4	4	38	95
R 6	4	3	3	4	3	3	4	4	3	4	35	87,5
R 7	4	3	3	4	3	3	4	4	4	3	35	87,5
R 8	4	3	3	4	4	4	4	4	4	4	38	95
R 9	4	3	3	3	4	4	4	4	4	3	36	90
R 10	4	4	3	4	4	3	4	4	4	4	38	95
R 11	4	3	2	4	4	4	4	4	4	4	37	92,5
R 12	4	4	4	4	3	4	4	3	4	3	37	92,5
R 13	4	3	4	4	4	3	4	4	3	3	36	90
R 14	4	4	4	3	4	4	3	4	4	3	37	92,5
R 15	4	3	4	4	3	3	4	4	3	3	35	87,5
R 16	4	3	4	4	3	4	4	3	4	3	36	90
R 17	4	3	2	4	4	4	4	4	4	4	37	92,5
R 18	3	4	4	3	4	4	4	4	4	4	37	92,5
R 19	4	3	4	4	4	4	4	4	4	4	39	97,5
R 20	4	4	4	4	4	3	4	4	3	4	38	95
R 21	4	3	4	4	4	3	4	4	4	3	37	92,5
Average											**37**	**92**

Based on the survey data, students gave a practicality rating of 92%, which falls into the "very practical" category. Students were enthusiastic about participating in the learning process and showed interest in using the Kebatar Media. Teachers observed the learning activities, tried using the Kebatar Media, and completed the teacher response survey. Based on the teacher response survey data, the practicality rating was 90%, which also falls into the "very practical" category.

3.5 Evaluation Stage

The final stage of the ADDIE model is evaluation. Evaluation was conducted by administering critical thinking skills questions. Tests were given to the research class before learning, called pre-tests, and after learning, called post-tests. Student abilities were measured using the N-Gain (Normality Gain) formula. The following is a summary of the pre-test, post-test, and N-Gain scores. The N-Gain data from the large group trial are presented in Table 9.

Table 9. The N-Gain Data from The Large Group Trial

Respondenst	*Pre test*	*Post test*	N-Gain
R 1	80	90	0,5
R 2	65	85	0,6
R 3	65	90	0,7
R 4	75	95	0,8
R 5	45	100	1,0
R 6	75	100	1,0
R 7	40	95	0,9
R 8	75	85	0,4
R 9	80	100	1,0
R 10	60	95	0,9
R 11	75	90	0,6
R 12	40	65	0,3
R 13	45	90	0,8
R 14	45	60	0,3
R 15	45	85	0,7
R 16	50	80	0,6
R 17	75	80	0,2
R 18	90	100	1,0
R 19	65	100	1,0
R 20	80	95	0,8
R 21	50	90	0,8
Average	62,85	89,04	0,71

Based on the data, it can be seen that the average student score on the pre-test was 62.85 and was categorized as incomplete because the minimum passing grade for mathematics was 70. After learning using Kebatar Media, the average post-test score increased to 89.04. The average student understanding of grade 2 flat shape material was 0.71, which is categorized as high. Based on the data, it can be concluded that the development of Kebatar Media based on local wisdom from Tulungagung has proven effective in enhancing students' critical thinking skills.

DISCUSSION

3.1 Validity of the Development of Flat Kendang Media Based on Local Wisdom of Reog Kendang Tulungagung

The validation was carried out by two experts, namely a material expert and a media expert. The media expert evaluated the visual appearance, navigation, media integration, and technical aspects of Kebatar. The results showed a validity percentage of 97%, falling into the highly valid category. The subject matter expert assessed the content, alignment with the curriculum, and depth of competencies. The validation results showed a validity percentage of 94%, also falling into the highly valid category. Based on the validation results by the experts, Kebatar Media is deemed highly suitable. The material presented aligns with the current curriculum and is systematically organized and easy to understand. Integration with technology provides a new learning experience, as students are not only passively receiving information but also actively participating in well-designed learning activities, thereby creating an enjoyable learning experience[15] . This is similar to the research conducted by [16] on “Development of Flat Shape Learning Media Based on QR Codes,” which showed a feasibility percentage by media experts of 96% in the very feasible category. Next is the research on “Development of RENATAMA,” which shows a validity percentage of 90% by media experts and 93.1% by

subject matter experts in the “highly feasible” category [12]. The research conducted by [13]on “Development of Ethnomathematics-Based Mathematics Learning Media to Enhance Critical Thinking” showed a validity level of 3.56 in the highly valid category [26],[27].

3.2 Practicality of Developing Media Based on Local Wisdom: Reog Kendang Tulungagung

Practicality tests were conducted on 21 second-grade students. The practicality percentage of the student questionnaire was 92%, and the practicality percentage of the teacher questionnaire was 97%. The average practicality percentage in the large-scale trial was 92%, so the product was categorized as very practical. The high level of practicality was evident from the questionnaire results and observations during the learning process. Students were able to follow the lessons well, and teachers also felt assisted in delivering the material. This indicates that the use of technology in basic education can improve time efficiency and strengthen the role of teachers as facilitators [28]. This statement is in line with previous research stating that the development of concrete media for assessing practicality by teachers was considered very practical with a score of 4.9 and a student response questionnaire score of 4.2 in the very practical category [11],[29]

3.3 Effectiveness of the Development of Flat-Shaped Media Based on Local Wisdom of Reog Kendang Tulungagung

To determine the effectiveness of the developed media, a critical thinking skills test was conducted before and after the use of the Kebatar Media (pre-test and post-test). The average pre-test score was 62.85, indicating that students' initial understanding was still limited. The average post-test score increased significantly to 89.04 after using the Kebatar media. The N-Gain calculation yielded a score of 0.71, which falls into the high category. These results indicate that the use of Kebatar Media can significantly improve students' critical thinking skills. Gamification in learning is an attractive feature because students feel like they are playing while learning. This is important in basic education because students still need visual stimulation and an enjoyable approach [30]. Research conducted by [31],[32] on shows that the effectiveness percentage of Interactive Media assisted by Quizizz is 78% in the effective category. The difference between the research conducted by the researchers and previous research is that to determine the effectiveness of a product, the researchers conducted an N-Gain analysis, while previous researchers used the percentage of students' post-test scores.

4. CONCLUSION

This study has successfully developed a mathematics learning medium that integrates local wisdom from Kendang reog into elementary school education in Indonesia. The Kebatar medium was designed to improve the critical thinking skills of second-grade students and demonstrated its effectiveness through testing. The findings of the study show that the validity of the Kebatar medium was obtained from media experts with a score of 97% and material experts with a score of 94%, both of which are considered highly valid. This indicates that the color composition, flat shapes, materials, appearance, and structure are appropriate for learning needs. Additionally, this media has proven to be practical and engaging from the perspectives of both students and teachers. This is evident from the student questionnaire scores of 92% and teacher questionnaire scores of 97%, both categorized as highly practical. The effectiveness of the media is evident from the improvement in students' critical thinking skills test scores. The average post-test score increased significantly compared to the pre-test, with an N-Gain value of 0.71, which falls into the high category. This indicates that the developed learning media is effective in helping students understand two-dimensional shapes more effectively.

This study, while successful in many respects, has several limitations that must be acknowledged. First, it is limited to a sample of second-grade students at Purworejo 02 Public Elementary School, which may not fully represent the diversity of the elementary school student population in other regions. Therefore, the results may not be generalizable to a broader educational context. Second, this study uses learning media specifically designed for specific material (Flat Shapes) in the subject of Mathematics. This limits the scope of the study to evaluating the effectiveness of the media in a broader context or other learning topics. Based on these limitations, recommendations for future research include conducting similar studies in various geographical locations and educational contexts to assess the effectiveness of Kebatar media among more diverse populations and in various educational environments. Developing and evaluating innovative mathematics learning media and implementing them in various elementary schools to gain a more comprehensive understanding of their effectiveness.

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