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The Effect of Interactive Engagement Strategy Using Quizizz on Students' Critical Thinking Skills on Chemical Bonding Material

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ABSTRACT

This paper discusses the effect of an interactive engagement strategy using Quizizz on students' critical thinking skills on chemical bonding material. This research used a quasi-experimental design because not all factors influencing learning can be controlled. This research was conducted in two experimental classes, the experimental and the control classes. The experimental class was given treatment in the form of an interactive engagement strategy using Quizlet. And the control class was given conventional model treatment. The sampling technique in this research is purposive sampling, which considers the homogeneity of the sample (class). The experimental and control class samples were 29 students from class X at MAN 1 Pekanbaru. The research results show that the ability to infer, namely making conclusions and presenting problems, dominates with the highest percentage value of 85%. On the other hand, analytical skills, which involve finding causes, assessing impacts, and predicting further impacts, recorded the lowest percentage with 50%. Overall, the average percentages for the four indicators reached 67.5%, which is in the good category. The Independent Sample T-Test statistical test, with a significance value (sig) of 0.000, revealed a significant difference in scientific literacy abilities between experimental and control class students. Of the N-Gain analysis, it is known that the average gain score for critical thinking skills in the experimental class (0.50 or 50%) is in the medium category, while the control class only reached 0.30 (30%), which is included in the low category. This shows a more significant increase in learning outcomes for critical thinking skills in the experimental class compared to the control class.

Keywords*: *interactive engagement strategy, quizizz, critical thinking skills, chemical bonds

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INTRODUCTION

Critical thinking skills are really needed in chemistry learning because they help students solve abstract problems and require quite complex understanding. Meanwhile, related research shows the phenomenon of students' lack of critical thinking skills in chemistry subjects. Research conducted (Susilowati et al., 2017) shows that the average skills of students at the State Madrsah Aliyah level in Magetan are classified as low. Research by Setianingsih & Roshayanti, (2022) shows that students' critical thinking abilities on the subject of reaction rate are very low (30.5%), low (38.8%), and very few have high critical thinking abilities (5.56%). Study Asriani (2021) found that students' critical thinking skills in chemical bonding material were still lacking (59.25%). This is because chemical bonding material requires a good understanding of microscopic and macroscopic concepts. Research by Khoirunnisa & Sabekti (2020) also found that students' critical thinking skills in chemical bonding material were relatively low, especially in the aspects of providing explanations, building basic skills, organizing strategies and tactics, and concluding. One effort to improve critical thinking skills during chemistry learning is to study independently so that students gain a more meaningful learning experience. The independent learning process is expected to develop three domains that are inherent in students, namely process, attitude and product. According to Sicilia (2016), these three domains need to be familiarized with in the learning process to carry out scientific processes in accordance with scientific methods.

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According to (McMillan et al., 2018) traditional and direct learning that is carried out continuously leads to the accumulation of superficial knowledge, and does not adequately train students to acquire the skills and attributes required of an effective scientist such as the ability to think critically, a clear mind curiosity, and the ability to think creatively. Furthermore, McMillan et al (2018) implemented a strategy with interactive and engaged concepts *which* is *called* interactive *-engagement strategy* . The findings explain that students' scientific skills can improve with interactive strategies with high student involvement.

Interactive-engagement strategy is a teaching strategy in which students engage in thoughtful activities that involve pre-reading a textbook before teaching a concept or practice. At the beginning of the lesson, students provide an interactive session to discuss concepts among themselves that were previously given as pre-class assignments. Questions about concepts are asked by the teacher at the end of the interactive session, students then discuss the questions, choose answers using learning media that support student interaction and then the teacher clarifies misconceptions (Ayodele, 2011) . During learning, students who are involved in *interactive engagement strategies* will be encouraged to participate because these activities stimulate critical thinking, require interaction with other students, and lead to deeper learning (Tlhoaele et al., 2014) . Thus, students who are actively involved because of *interactive engagement* will dedicate their attention, time and energy to the learning process (Kuh, 2003) .

The use of quizzes (*quizizz)* is used as a stimulus so that students become more actively involved in learning in class so that it is not boring (Jumini et al, 2022). *Quizizz* is a *web tool* for creating interactive quiz games that can be used in learning in class or outside of class in the form of *homework* . In the interactive quiz created, there are 4 answer choices including the correct answer, an image can be added to the background of the question. When the creation of this quiz has been completed, students can log in to the quiz using the code that we shared, or log in via the link that we shared. This *Quizizz* is very interesting because it can be accessed directly via a browser, and can also be downloaded via Playstore. In this *quizizz* , teachers can determine the processing time for each question item, can find out the number of students who have logged in, find out the students' results, save, print and send the results of students' assignments to parents in the form of an Excel file (Pujiati & Patimah, 2021).

Quizizz application is different from other educational applications, offering many game features to make learning more entertaining. *Game* -based learning media is a type of learning media that combines quizzes or evaluation material to make learning more entertaining, fun and interesting. According to Jumini et al (2022), the use of *games* has a positive impact, one of these benefits is that games provide logic and problem solving exercises in an entertaining and fun way. Applications like this are worthy of being used as interactive learning media applications in the current 5.0 era, because the learning process becomes simpler and the evaluation process produces faster results, students will become more motivated and interested in learning . So that through the help of *Quizzizz* , students will become more engaged *in* the learning process and improve their critical thinking skills through this focused learning experience.

A preliminary study conducted at MAN 1 Pekanbaru revealed that chemistry teachers had never implemented an *interactive engagement strategy*, apart from that the learning method applied so far had never been combined with *quizizz*. The interviews conducted also asked about chemistry learning problems related to class demanding arguments, students also appear to have difficulty finding logic related to the chemical concepts they have studied, apart from that, students are often unable to solve problems if the form of the question is changed from the example solution that has been explained by the teacher.

Previous studies have primarily focused on the general benefits of Quizizz in promoting student engagement and motivation without delving deeply into its implications for critical thinking skills. For instance, research by Hamari et al. (2016) highlights the positive influence of gamified assessments on student attitudes and participation, but few studies have systematically investigated how these interactive strategies specifically enhance critical thinking in complex subjects like chemistry. Moreover, existing literature often overlooks the nuances of how different types of quiz questions—such as multiple-choice

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versus open-ended questions affect students' cognitive processes and critical thinking development (Karpinski & Duberstein, 2017).

This study aims to fill this gap by examining the effects of an interactive engagement strategy using Quizizz on students' critical thinking abilities specifically in chemical bonding material. By focusing on this intersection, the research seeks to provide insights that could inform pedagogical practices and enhance instructional strategies in science education. The findings will contribute to a more comprehensive understanding of how gamified learning environments can be leveraged to foster higher-order thinking skills among students, thereby addressing a crucial aspect that has been underexplored in current educational research. These phenomena illustrate that students at MAN 1 Pekanbaru have symptoms of low critical thinking abilities. So, based on the problems above, it is necessary to carry out research with the title "The Effect of *Interactive Engagement Strategy* Using *Quizizz* on Students' Critical Thinking Ability on Chemical Bonding Material".

LITERATURE REVIEW

Interactive Engagement Strategy

The Interactive Engagement (IE) strategy is a pedagogical model aimed at enhancing students' comprehension of complex concepts through active participation and collaboration among peers. Ruo (2002) defines it as a method that fosters interactive relationships among students, facilitating feedback and enhancing the learning process. This model emphasizes student-centered activities designed to deepen understanding and promote critical thinking in subjects such as physics (Turpen & Finkelstein, 2009). Research has demonstrated that IE approaches can lead to significant improvements in students' conceptual understanding and problem-solving abilities, particularly in mechanics (Antwi et al., 2011). Hake (1998) further supports this by showing that courses employing interactive engagement techniques yield greater learning gains compared to traditional lecture-based methods.

Quizizz

Quizizz is an interactive quiz platform that facilitates engaging classroom learning experiences, allowing for daily assessments as well as mid-term and final evaluations (Suhartatik, 2020). It transforms traditional assessment methods into more dynamic and enjoyable activities for students, thereby promoting active participation in the learning process (Marunung & Nurhairani, 2020). The effectiveness of Quizizz lies in its ability to provide immediate feedback, which is crucial for reinforcing learning and enhancing retention. This aligns with findings from various studies indicating that gamified learning environments can significantly boost student engagement and motivation.

Critical Thinking

Critical thinking is defined as the ability to use effective mental processes to pursue relevant and accurate knowledge about the world. It encompasses reasonable, reflective, and responsible thought processes that guide individuals in making informed decisions (Dwijananti & Yulianti, 2010). Developing critical thinking skills is essential for students to adapt to the rapidly evolving landscape of science and technology. According to Putri and Sobandi (2019), critical thinking involves a deep understanding of problems and the generation of innovative solutions. The cultivation of these skills is increasingly recognized as a vital component of education, particularly in STEM fields, where analytical reasoning and problem-solving are paramount.

METHOD

Research Method

This study employed a quasi-experimental design to investigate the effects of an interactive engagement strategy using Quizizz on students' critical thinking abilities in chemical bonding material. Quasi-

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experimental research is particularly suitable in educational settings where controlling all variables is not feasible, allowing for the examination of specific variables, such as critical thinking skills, in a realistic context (Arikunto, 2012).

Population and Sample

The research was conducted in the 10th-grade classrooms of MAN 1 Pekanbaru during the academic year 2023/2024. The data collection commenced in November 2023, focusing specifically on assessing students' critical thinking abilities through pretests and posttests. The sampling technique utilized was purposive sampling, which ensured homogeneity among the classes selected for the study. The experimental group consisted of 29 students who engaged with the Quizizz platform, while the control group also comprised 29 students who received traditional instruction without the interactive engagement strategy.

Research Instruments

To collect data on students' critical thinking abilities, several instruments were employed:

Pretest and Posttest: These assessments measured students' critical thinking skills before and after the intervention. The tests were designed to evaluate various indicators of critical thinking, including analysis, evaluation, and inference.

Observational Data: This was collected to complement quantitative data from pretests and posttests. Observational ratings were categorized based on performance scores, as shown in Table 1:

Table 1. Rating Category Observational Data

Score	Criterion
81-100	Very Good
61-80	Good
41-60	Enough
21-40	Low
0-20	Very Low

(Sugiyono, 2013)

Data Collection Techniques

Data collection involved administering pretests prior to the implementation of the interactive engagement strategy and posttests afterward to assess changes in critical thinking abilities. Additionally, observational data were gathered throughout the instructional period to provide qualitative insights into student engagement and participation.

Data Analysis Techniques

Data analysis was conducted to determine whether the hypothesis regarding the effectiveness of Quizizz on enhancing critical thinking abilities was accepted or rejected. The analysis included several steps:

Normality Test: This test assessed whether the data followed a normal distribution, using the Kolmogorov-Smirnov test via SPSS version 26.

Homogeneity Test: Conducted to determine if variances between groups were homogeneous or heterogeneous, utilizing Levene's test in SPSS version 26.

Hypothesis Testing: If data met normality assumptions, an independent sample t-test was performed using SPSS version 23 to compare pretest and posttest results between experimental and control groups.

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The criteria for interpreting normalized N-gain results are summarized in Table 2:

Table 2 Response Questionnaire Results Criteria

Percentage	Categories
< g > ≥ 0.70	Tall
0, 30 ≤ < g > < 0.70	Currently
0.00 < g > 0.30	Low

(Sugiyono, 2013).

RESULTS AND DISCUSSION

Research results

The research procedure was carried out in three stages, namely the planning stage, implementation stage and assessment stage.

1. Planning Stage

The steps taken in the planning stage are as follows:

a. Prepare a Learning Implementation Plan (RPP)

The Learning Implementation Plan (RPP) is a learning plan for each subject per unit that will be carried out by the teacher during class learning. Learning Implementation Plans (RPP) are made for each CP and ATP, so one RPP may contain several meetings according to the provisions of the syllabus.

b. Preparing Student Activity Sheets (LKPD)

Student Activity Sheets (LKPD) are part of the Learning Implementation Plan (RPP) which helps to achieve learning indicators through activities (*Hands on Activity*) and thinking (*Minds on Activity*) so that students gain cognitive, affective and psychomotor abilities. The preparation of the LKPD was carried out by following the characteristics of the *interactive engagement strategy method* and reflecting aspects of critical thinking skills.

c. Preparing the Test Instrument Grid

To be able to make good questions, you need a question grid. The preparation of the question grid needs to pay attention to (Learning Outcomes, Flow of Learning Objectives, Indicators of critical thinking abilities, realm of cognitive level to be achieved). The material chosen is chemical bonds which consist of ionic bonds, covalent bonds, metallic bonds, molecular shapes and interactions between molecules. The Learning Outcomes are translated into 4 Learning Goal Flow indicators. The results of this analysis produce indicators for the critical thinking ability assessment instrument consisting of 10 indicators.

d. Creating Critical Thinking Ability Test Items

In developing this assessment instrument, several things need to be considered, namely good assessment criteria, adapting the assessment instrument to the learning material, and the scope of content and material being taught. The assessment instrument developed is a grid of critical thinking ability questions in the form of choice questions arranged based on CP and ATP indicators, indicators of critical thinking ability. The ATP indicator was developed in accordance with CP for high school chemical bond material in accordance with the Independent Curriculum.

The critical thinking ability assessment instrument is specifically designed to measure students' critical thinking abilities. The questions are expected to be able to analyze students' critical thinking abilities, so that the level of students' abilities can be measured or known.

2. Implementation Stage

Learning in both classes is carried out based on the RPP that has been designed. in the context of a learning experiment, two class groups applied different learning methods. The experimental class adopted an interactive approach by implementing an interactive engagement strategy using Quizizz, in accordance with a specially designed Learning Implementation Plan (RPP). On the other hand, the control class received

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treatment in the form of a conventional learning model, which was also implemented in accordance with the conventional RPP. This experiment was aimed at comparing the impact of the two learning approaches on student outcomes and engagement. Thus, this research aims to evaluate the effectiveness of interactive strategies in learning compared to conventional models.

The observations carried out in this research aim to determine indicators of students' critical thinking abilities during the learning process using the *interactive engagement strategy learning model* . This learning model consists of six stages. These results were obtained through observations made by two observers during the learning process. Before making observations, observers are given technical guidelines for observations in the form of a rubric and how to fill out the observation sheet that will be used. This is done so that all observers have the same views when making observations. The results of observing the critical thinking skills of 29 students throughout all learning activities are presented in Table 3.

Table 3. Observation Results of Critical Thinking Ability

No.	Observed Aspects	Initial Observations		Final Observations		Total	Percent
		Score	%	Score	%		
1.	Understand the problems involved in learning and formulate questions according to the topics discussed	6	60	8	80	14	70
2.	Finding the causes of events, assessing the impact of events, and predicting further impacts	4	40	6	60	10	50
3.	Design solutions based on problems found	6	60	7	70	13	65
4.	Make appropriate conclusions then communicate/present the problem	7	70	10	100	17	85
Amount		23		31		54	
Final Percentage (%)		57.5		77.5		67.5	
Category		Enough		Good		Good	

Based on Table 3, of the four indicators of critical thinking abilities studied, there is one indicator in the very good category, two indicators in the good category and one indicator in the sufficient category. The highest average percentage is found in the inferencing indicator (making appropriate conclusions then communicating/presenting the problem) with a percentage value of 85%. Meanwhile, the lowest average percentage is found in the analyzing indicator (finding the cause of an event, assessing the impact of an event, and predicting further impacts) with a percentage value of 50%. The average value of the overall indicator is 67.5% in the good category.

3. Assessment Stage

Data collection is needed to see the increase in students' grades before implementing interactive engagement strategy learning with Quizzizz in the experimental class and conventional learning in the control class. This stage was carried out with the aim of finding out the effectiveness and influence of implementing interactive engagement strategy learning on students' critical thinking abilities. The influence of implementing interactive engagement strategy learning on students' critical thinking abilities will be seen through students' pretest-posttest data using a multiple choice question instrument totaling 30 questions created based on indicators of critical thinking abilities. The results of measuring critical thinking skills can be presented in the form of descriptive statistics in the form of average values (mean) and improvements for both the control class

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and the experimental class. These results can be presented in the following table.

Table 4. Descriptive Statistics of Critical Thinking Ability Values

	Experimental Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Sample	29	29	29	29
Average	30.84	66.24	25.03	53.62
Max Value	50	80	60	67
Min Value	10	57	10	43

Based on the data in table 4, it can be seen that the total sample for the experimental and control classes was 29 people. The average score of the experimental class before learning was 30.84 and increased to 66.24 in the average score after learning. The average score of the control class before learning was 25.03 and increased to 53.62 in the average score after learning. The highest score in the experimental class before learning was 50 and after learning was 80, while the lowest score before learning was 10 and after learning was 57. The highest score in the control class before learning was 60 and after learning was 67, while the lowest score before learning is 10 and after learning is 43.

a. Critical Thinking Ability Data Normality Test

The normality test was carried out using the SPSS version 24 application by looking at the results of the Kolmogorov-Smirnov test with a significance level of 0.05. The Kolmogorov-Smirnov method is a normality test method that is effective and valid for large samples. Regarding the number of samples to be tested, "If the number of samples tested is >50, Kolmogorov-Smirnov is used, whereas if <50 samples are tested, Shapiro-Wilk is used" (Dahlan, 2010). The normality test results for each variable are as follows:

Table 5. Normality Test of Critical Thinking Ability

Class		Kolmogorov-Smirnov	Conclusion
		Sig.	
Pretest	Experiment	0.055	Normal Distribution
	Control	0.200	Normal Distribution
Posttest	Experiment	0.058	Normal Distribution
	Control	0.064	Normal Distribution

Based on the significance level in table 5 which has been presented for the normality test, it shows that the Critical Thinking Ability pretest and posttest scores for the control and experimental classes are normally distributed, this is indicated by a significance level of more than 0.005 or p>0.005. So it can be concluded that all data is normally distributed.

b. Data Homogeneity Test for Critical Thinking Ability

The data tested is said to be homogeneous based on its significance value. A significance value (p) ≥ 0.05 indicates that the data group comes from a population that has the same variance (homogeneous). A significance value (p) < 0.05 indicates that each group of data comes from a population with a different variance (not homogeneous).

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Table 6 Homogeneity Test Results

Variable	Levene Statistics	df1	df2	Sig.
Pretest	3,034	1	56	0.087
Posttest	0.940	1	56	0.336

Based on table 6, it can be seen that the significance value is > 0.05, which means the data is homogeneously distributed so it is suitable for use.

c. Hypothesis Testing Critical Thinking Ability Data

From the results of the normality test for Critical Thinking Ability data for the control class and experimental class, it shows that the data is normally distributed. Based on the results of these prerequisite tests, parametric testing can be continued so that the data will be analyzed using the Independent Sample T-Test.

Table 7 T-test Critical Thinking Ability

Class		N	Mean	elementary school	t-test for equality of means				Conclusion
					F	t	df	Sig. (2-tailed)	
Pretest	Experiment	29	30.83	13,366	3,034	1,765	56	0.083	Ha Accepted (There are differences)
	Control	29	25.03	11,568					
Posttest	Experiment	29	66.24	6,045	0.940	7,213	56	0,000	
	Control	29	53.52	7,327					

Based on the results of the Independent Sample T-Test statistical test above, the sig (2-Tailed) t test value for students' critical thinking abilities is 0.000. Because the sig (2-Tailed) value is <0.05, H0 is rejected and Ha is accepted. Thus it can be concluded that there is a significant difference in students' Critical Thinking Ability between the experimental class and the control class. The increase in students' critical thinking abilities in the control and experimental classes can be seen through calculating *the normalized gain score* . The analysis results are shown in the following table.

Table 8. Data on improving learning outcomes in the experimental and control classes

Class	Average N-Gain	Category	Frequency	Percentage (%)
Experiment	0.50 (Medium)	Tall	1	3,4
		Currently	26	89.7
		Low	2	6.9
Amount			29	100
Control	0.30 (Low)	Tall	0	0.0
		Currently	25	86.2
		Low	4	13.8
Amount			29	100

From the results of the analysis above, it can be seen that the average gain score for students' critical thinking abilities in the control class is 0.30 (30%), which is included in the low category. Meanwhile, the average gain score for critical thinking skills in the experimental class is 0.50 (50%) and is included in the medium category, so it can be concluded that there is a difference in critical thinking ability scores between the control class and the experimental class. In the experimental class there was an increase in learning outcomes with an average N-Gain of 0.50. This value is included in the medium category ($0.30 \leq N - Gain$

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≤ 0.70).

Research Discussion

Based on the results of the analysis, it can be concluded that there are differences in students' scientific literacy abilities for each indicator in both the experimental class and the control class. However, when compared, the experimental class scores are superior to the control class scores. This can be proven by the results of the analysis, namely, the experimental class got an average score of 66, the control class got an average score of 53. Based on critical thinking indicators, it is known that there are differences in the thinking abilities of students who have been treated with *interactive engagement strategy learning* with students who have only received conventional learning. Experimental class students are superior, this is because students are able to understand material about phenomena that has been presented through questions. If it is integrated into scientific competence, then students on average are able to explain phenomena scientifically, as emphasized by Marita & Abidin (2018) that one of the areas of scientific competence is explaining phenomena scientifically. Meanwhile, the lowest achievement in scientific literacy for experimental class students was in the scientific knowledge indicator. This is because students lack mastery of the facts that occurred and lack mastery of the theory of material explanation. This is explained in Abidin (2018) that the area of scientific knowledge must include an understanding of the main facts, concepts and explanatory theories that form basic knowledge.

The differences in the critical thinking abilities of students in the control and experimental classes are influenced by several factors, including differences in the level of intelligence of each student, the psychological condition of students, the condition of supporting facilities and infrastructure, material support from parents and environmental conditions in the classroom. while learning takes place. The level of questions given is higher than usual because students are less trained in working on questions such as critical thinking questions, especially since so far there has never been any measurement of critical thinking abilities. This is of course something new for students and requires a long time to train themselves and get used to working on questions at a higher level so that students' critical thinking abilities can be measured well.

There is an influence of learning models and teaching materials on critical thinking skills because students are able to gather information independently and try to solve problems well by reading valid sources. Apart from that, students can be active during group discussions and presentations of discussion results in order to practice communication skills between students and teachers. Melda Ariyanti (2017) emphasized that someone who has high-level thinking abilities can be classified as a quality human being because having this ability a person can solve problems from the simplest to the most complex. Apart from that, good problem solving skills can train students to filter relevant information and increase students' intellectual potential. The stage of presenting a problem to students can refer students to solve the problem by collecting relevant information, discussing and drawing up conclusions from the discussion results. After a conclusion has been reached from the results of the discussion, students present and explain the problem being solved and the solution. This can trigger students' self-confidence as well as skills in communicating and expressing opinions. The position of the educator in this learning is as a facilitator and students are active in the learning process in order to gain learning experience through the use of teaching materials , gathering information and solving problems.

CONCLUSIONS AND RECOMMENDATION

The research results show that in particular, the ability to infer, namely making conclusions and presenting problems, dominates with the highest percentage value of 85%. On the other hand, analytical skills, which involve finding causes, assessing impacts, and predicting further impacts, recorded the lowest percentage, namely 50%. Overall, the average percentage for the four indicators reached 67.5%, which is in the good category. The results of the Independent Sample T-Test statistical test, with a significance value (sig) of 0.000, can be concluded that there is a significant difference in scientific literacy abilities between

experimental class and control class students. From the N-Gain analysis, it is known that the average gain score for critical thinking skills in the experimental class (0.50 or 50%) is in the medium category, while the control class only reached 0.30 (30%), which is included in the low category. This conclusion shows that there is a more significant increase in learning outcomes for critical thinking skills in the experimental class compared to the control class. Learning based on interactive engagement strategies is recommended to be carried out more often because it can train students' critical thinking skills provided that they are trained continuously.

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