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Exploring the use of instructional video materials in teaching measures of central tendency

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Abstract
Educational video tutorials are currently modern teaching resources. Students today are using educational videos as a tool for learning everything. Studies have shown that the use of short video clips allows for more efficient processing and memory recall. The visual and auditory nature of videos appeals to a wide audience and allows each user to process information in a way that's natural to them. This research used quasi-experimental research which is designed for the researcher to gather data about the use of instructional video materials in teaching measures of central tendency in Oslob National High School. One factor within this study is the gap in the mathematical performance of the students due to the pandemic. The study employed two groups (controlled and experimental) of grade 7 students and each group consisted of 52 students. They were given different mediums of instruction; the first group, which is the controlled group was given the traditional way of teaching where the teacher gave the instructions and discussed the lesson. On the other hand, the experimental group used a combination of text, videos, and audio to facilitate the learning process of the students. Results suggest that using instructional video materials does not cause a significant difference in the competency level of the students. Therefore, it is evident from the study conducted that the use of instructional video materials in teaching Mathematics and pure classroom teaching facilitated by the teacher are both helpful and comparable. Thus, instructional video materials can be integrated into the mathematics curriculum.

Keywords: Instructional video materials, quasi-experimental, teaching resources, pandemic

Introduction

Before the onset of the COVID-19 pandemic, mathematics had long been recognized as a challenging subject for many students (Lalian, 2019; Beltran, 2021). The difficulties in mastering mathematical concepts were exacerbated during the pandemic, as students grappled with remote learning and limited access to educational resources (Sawchuck & Sparks, 2020). This struggle was further compounded by the lack of proper training among parents who attempted to support their children's learning at home.

Unequal access to learning resources has exacerbated mathematics learning loss, with students facing significant setbacks in their mathematical proficiency (Haser *et al.*, 2022). Notably, research suggests that students are more likely to experience greater regression in mathematics compared to other subjects (Sawchuck & Sparks, 2020). Addressing this challenge requires collaborative efforts among educators, administrators, and parents to enhance mathematics instruction and mitigate learning loss during the pandemic.

Understanding mathematics is crucial for students' academic development, as it forms the foundation for advanced learning across various disciplines. The hierarchical nature of mathematical concepts necessitates a comprehensive understanding of fundamental principles to support continued academic progress. Engaging students in the learning process is essential for fostering motivation and deeper comprehension of mathematical concepts, particularly among male students (Erdem-Keklik & Keklik, 2013).

In the Philippines, Filipino learners perform below average in Mathematics at almost all levels nationwide and in international assessments based on the results of the National Achievement Tests (NAT), Program for International Students Assessment (PISA) 2018, and Trends in International Mathematics and Science Study (TIMSS) 2019 (Gonzales, 2019; Department of Education, 2019; Mullis *et al.*, 2019) [8]. The Mathematics performance of Filipino learners during this pandemic would likely hit rock bottom due to unequal access to quality education (UNICEF Philippines, 2021). There has been an initiative to integrate technological advancements in the classroom to advance the quality of education. It is essential to facilitate educational development in this area because students are constantly bounded by digital devices and must obtain technological literacy to be productive members of society in various uses such as at home, in school, and in the community as also specified by the Organization for Economic Cooperation and Development (OECD).

Incorporating technology into mathematics instruction has emerged as a promising strategy to enhance student engagement and facilitate deeper learning experiences. Technology-enabled learning not only increases student motivation but also improves teacher-student interaction, fosters collaboration, and enhances the accuracy of mathematical computations (Murphy, 2016) [12]. Moreover, technology integration cultivates higher-order thinking skills that are essential for students' success in an increasingly technology-driven society.

Despite the potential benefits of technology in education, challenges persist in effectively leveraging instructional tools to support student learning, particularly in mathematics. In the Philippines, where students' mathematics performance lags behind international standards, there is a pressing need to integrate technological advancements into the classroom to improve educational outcomes (Gonzales, 2019; Department of Education, 2019; Mullis *et al.*, 2019) [8]. The COVID-19 pandemic has

underscored the importance of innovative teaching approaches, such as video tutorials, to facilitate remote learning and address educational disparities.

Tan *et al.* (2020) revealed that learning via video engaged students with learning difficulties in mathematics compared with the traditional approach. Hence, utilizing technology in education assists students in understanding mathematical concepts better (CunHua *et al.*, 2019; Huang *et al.*, 2016) and improves student academic achievement (Wijaya *et al.*, 2020; Zhang *et al.*, 2020). Learning using videos improves the students' mathematics learning outcomes (Rahmadani & Nurlaelah, 2019). These justify the use of videos in delivering mathematics lessons.

Video tutorials have emerged as effective instructional tools for delivering content concisely and engagingly (Worlitz *et al.*, 2016) [17]. Research indicates that video tutorials can enhance students' understanding of mathematical concepts and improve academic performance (Tan *et al.*, 2020; Rahmadani & Nurlaelah, 2019). By investigating the effectiveness of instructional video tutorials in mathematics education, this study seeks to contribute to the ongoing efforts to enhance student learning and address the challenges posed by the pandemic.

Moreover, the student's motivation to follow this lesson will be so low that it affects the cognitive and psychomotor aspects of the student in this lesson. Almost every Math teacher agrees on the importance of corrective feedback for the teaching and learning process. Students, except those who naturally desire Mathematics, need to be stimulated through appropriate techniques and ways of learning. It is believed that by employing these methods of teaching, students' problems, such as anxiety about Mathematics, can be reduced or eliminated. One way or method that can be applied is ICT-based learning by utilizing instructional media as a means of learning, and one of the learning media that can be used is audiovisual and video.

Instructional videos tend to be short and are designed to teach a specific skill (Pai, 2014; Shipper, 2013), but they are neither dynamic software nor interactive. Videos are short (3-4 minutes) and to the point, designed to focus on one or two main ideas. They are designed with the intent to hold viewers' attention for the duration of the video, and a single one can provide knowledge about several topics. Integrating instructional videos into the classroom is not a new concept but one that is increasingly popular (Shipper, 2013).

It was also observed that in the classroom setting, learners' mathematical performance is low. This is reflected in the low scores of the learners. The possible reasons are poor reading comprehension in solving mathematical word problems, lack of guidance and assessment in the progress of reading and solving skills, and low interest in the subject.

In this modern era, students tend to participate when teachers integrate technologies into the teaching-learning process. Technologies are smartphones, televisions, and other multimedia. On the other hand, traditional teaching includes the use of printed photos, charts, flashcards, and others. Meanwhile, using videos for instructions is advantageous and suitable in this era since most students are inclined to the use of modernized technologies, unlike the traditional way where students find it boring and unrelatable.

The global problem of Mathematics is also observed in the micro area like Oslob. The researcher has observed that learning Mathematics has been a challenge to every learner, specifically to Grade 7 and it would require an approach that is suitable to their generation.

The use of video instruction is a helpful tool to facilitate the learning process of the learner. During the pandemic, students are not allowed to go to school, and they are given school instructions through online platforms. Despite the growing prevalence and accessibility of video instructions in various educational settings, there remains a significant gap in understanding the differences between video instructions and traditional teaching methods across diverse learning populations, educational contexts, and subject matters. The teaching of Mathematics among students through the use of video instructions and traditional teaching methods has a different impact on learning Mathematics.

Additionally, the creation and assessment of the video lessons centered on how the researcher's video lectures were developed over time. Results showed that video lessons are useful in all areas of the classroom, and teachers can utilize them to allocate time and space for active learning. This indicates that the student's performance in teaching and learning will increase to higher levels. Students, as well as professors, are happy with their work. It is possible to create and use a video lesson to enhance the student achievement level in mathematics (Jerremias & Carretero, 2022) [1].

Specifically, this research aims to assess the impact of video tutorials on the mathematical performance of Grade 7 learners at Oslob National High School. By evaluating the effectiveness of instructional videos in improving students' mathematical competencies, this study aims to inform instructional practices and support students' cognitive and affective learning experiences. Ultimately, this research endeavors to enhance the learning process and promote academic success through the integration of instructional videos in mathematics education.

The focus of the study is to assess the effectiveness of video tutorials as educational technology in improving identified mathematical competencies of Grade 7 learners in Oslob National High School for the School Year 2022-2023 as the basis for the proposed instructional plan.

Methodology

The research employed a quasi-experimental design, which was deemed appropriate for examining the effectiveness of instructional video materials in teaching measures of central tendency at Oslob National High School. Quasi-experimental research involves the manipulation of an independent variable without the random assignment of participants to conditions or orders of conditions (Cook & Campbell, 1979) [4]. Important types of quasi-experimental designs include nonequivalent groups' designs, pretest-posttest comparisons, and interrupted time-series designs.

By utilizing a quasi-experimental design, this research aimed to address the directionality problem by manipulating the independent variable. However, it is important to note that quasi-experimental designs do not fully eliminate the issue of confounding variables, as they do not involve random assignment to conditions. Consequently, while quasi-experimental research generally offers higher internal validity compared to correlational studies, it typically exhibits lower internal validity compared to true experiments.

The sections involved in this study were the sections in grade 7: Rose (lecture method) and Daisy (Video Integration). The implementation of the study was done for

one (1) week and one (1) day (7 hours) this was based on the MELCS of DepEd curriculum guide. The lecture method, was a plain teaching while using the PowerPoint presentation, the pretest was done before the discussion. In the discussion process, students were asked some questions on how to solve the mean, median, and mode, they were also asked about some real-life situations wherein the concept of measures of central tendency is being applied. Lastly, they were given group activity and formative assessment to check their knowledge of the topic. For 2 hours, the researcher let them answer the posttest, this is to test their knowledge if they have gained their scores from the pretest. For the video integration, the researcher played the video on the screen then they watched the video 2-3 times. The teacher elaborated on some parts of the video that which the learner didn't understand. They were also asked some questions on how to solve the mean, median, and mode and they were able to give some real-life problems wherein the concept of Measures of central tendency is being applied. After watching the video, they gave their examples then group activity and formative assessment were done. For 2 hours, the researcher let them answer the posttest, this is to test their knowledge if they have gained their scores from the pretest. The lesson topic was determined by referring to the competencies stipulated in DepEd K-12 Mathematics Curriculum Guide in Grade 7: illustrates the measures of central tendency: mean, median, and mode of statistical data; calculates the measures of central tendency of ungrouped data and solves problems involving measures of central tendency.

The study was conducted at Oslob National High School, Municipality of Oslob, Cebu. Located in the southern part of Cebu bounded by the Municipality of Boljoon going to the north and Santander going to the south. The researcher chose to conduct the study in Oslob National High School since most of the teachers handling Mathematics in grade seven found out that students had a hard time learning measures of central tendency. It is also convenient for the researcher since the researcher is one of the faculty members of the said school.

The respondents of the study are the Grade 7 learners of the school. The respondents are significant in the study because mathematical skills and logical thinking skills are given more emphasis at this year's level. The Grade 7 learners have a total enrollment population of one hundred four (104) learners. The grade 7- Rose was the control group and the grade 7- Daisy was the experimental group.

Table 1: Distribution of Respondents

	Grade 7- ROSE		**Grade 7- DAISY**	
Gender	Frequency f	Percentage %	Frequency f	Percentage %
Male	21	40.38	27	51.92
Female	31	59.62	25	48.08
Total	52	100	52	100

The researcher utilized a researcher-made questionnaire for the pre-test and post-test to collect the quantitative data required. The research instrument was validated by the subject coordinator following the Table of Specifications (TOS) to establish content validity. It was ensured that the questions were aligned with the different learning competencies as reflected in the TOS.

After the pre and post-tests were checked, the researcher pilot-tested the research instrument to the grade 9 students to test its reliability and validity. It used Cronbach's Alpha test and it obtained a value of 0.8239.

Concerned authorities were asked for approval before the actual data gathering. The researcher wrote a letter to the school principal seeking his permission and approval to conduct a study on grade 7 students. Once approved by the principal and subject teachers, an orientation was given to the learners for a better understanding of the entire study and assured them that their answers would be handled privately and confidentially. Then, administration of the questionnaire and collection of the needed data followed. After the collection of data, tallying and tabulation of results commenced, breakdown and explanation of the results were done. The result of the interpretation and conclusion served as the basis for a proposed mathematical performance assessment intended for learners.

To answer the specific problems of the study, 1. Frequency and Simple Percentage; and T-test were utilized to analyze the data gathered.

The researchers cite Lincoln and Guba (1985) to emphasize the importance of demonstrating the trustworthiness of research findings to both themselves and readers. They introduce criteria such as credibility, transferability, dependability, and confirmability, which parallel the traditional quantitative assessment criteria of validity and reliability. Despite differences in epistemology and ontology, these criteria are familiar to many researchers and rely on methodological arguments and techniques. While other approaches to assessing quality in qualitative research exist, the researchers opt to use Lincoln and Guba's original criteria for trustworthiness, arguing that they are widely accepted and easily recognizable. They assert that these criteria are pragmatic choices for researchers concerned about the acceptability and usefulness of their research to various stakeholders. Throughout the study, the researchers aim to demonstrate trustworthiness through a thematic analysis by integrating these criteria into their methodology.

Results and Discussion

This part compromises the presentation, analysis, and interpretation of the data gathered from the respondents which are used in exploring the use of instructional video materials in teaching measures of central tendency. Specific statistical tools were used and utilized in the interpretation of the data collected to arrive at accurate results.

Specifically, this chapter is divided into two parts. The first part is comprised of the respondent's significant difference between the mean pre-test and post-test scores of the students in both the Controlled and Experimental groups. The second part is comprised of the significant mean gain between the two groups after the exposure to instructional video materials.

Controlled Group

This part shows the mean difference between the pre-test and post-test scores of the controlled.

Table 2: Mean Difference between the Pre-test and Post-test Scores of the Controlled Group

Competencies	Tests	Mean	Computed t-value	Critical t-value	Decision	Interpretation
illustrates the measures of central tendency: mean, median, and mode of statistical data	Pretest	3.87	12.45	2.01	Reject Ho	Significant
	Posttest	7.33				
calculates the measures of central tendency of ungrouped data; and	Pretest	2.63	14.80	2.01	Reject Ho	Significant
	Posttest	6.25				
solves problems involving measures of central tendency	Pretest	2.62	10.26	2.01	Reject Ho	Significant
	Posttest	5.38				
Totality	Pretest	9.10	17.59	2.01	Reject Ho	Significant
	Posttest	18.94				

Table 2 shows the mean difference between the pre-test and post-test of the controlled group. As a result, in the three competencies, the data shows that the mean of the pre and post-tests differ. The pre-test mean score of the first competency is 3.87 while the post-test is 7.33 with a computed t-value of 12.45 and critical t-value of 2.01; the second competency the pre-test mean score is 2.63 while the post-test is 6.25 with the computed t-value of 14.80 and critical t-value of 2.01; the last competency pre-test mean score is 2.62 and the post-test is 5.32 with the computed t-value of 10.26 and critical t-value of 2.01 which led to the rejection of the null hypothesis which means that there is a significant difference between the pre-test and post-test scores of the students on the tests that were conducted. This means that students have improved their performance from the pre-test.

According to the theory Gagne (1984) described learning as a change in the behavior of an individual that is retained and that makes possible a corresponding change in his or her behavior in a particular situation. According to him, learning is a process that takes off inside an individual's brain. The most important aspects of a learner are 'his senses, his central nervous system, and his muscles. Learners learn best when information is presented in logical sequences consisting of short units with a clear framework.

In totality, the pre-test has a mean of 9.10, while 18.94 is the mean score of the post-test. It has a computed t-value of 17.59 which is greater than the critical t-value of 2.01 which means that the results are statistically significant and the results show that there is enough evidence to reject the null hypothesis. Therefore, the null hypothesis is rejected and is interpreted that there is a significant difference between the conducted pre and post-test within the controlled group. Thus, students increased their scores in the post-test leading to improved performance even with the use of the conventional method.

Experimental Group

This part shows the difference between the pre-test and post-test that were conducted within the experimental group. This group of students was given the same post-test assessments which covered the three (3) competencies that are present in the K to 12 Most Essential Learning Competencies. The following competencies are - illustrates the measures of central tendency: mean, median, and mode of statistical data, calculates the measures of central tendency of ungrouped data and solves problems involving measures of central tendency.

Table 3: Mean Difference between the Pre-test and Post-test Scores of the Experimental Group

Competencies	Tests	Mean	Computed t-value	Critical t-value	Decision	Interpretation
illustrates the measures of central tendency: mean, median, and mode of statistical data	Pretest	3.50	12.68	2.01	Reject Ho	Significant
	Posttest	6.77				
calculates the measures of central tendency of ungrouped data; and	Pretest	2.25	11.87	2.01	Reject Ho	Significant
	Posttest	6.40				
solves problems involving measures of central tendency	Pretest	2.37	11.59	2.01	Reject Ho	Significant
	Posttest	5.06				
Totality	Pretest	8.06	15.55	2.01	Reject Ho	Significant
	Posttest	18.35				

As shown in the table, in the three competencies the data shows that the mean of the pre and post-test differ. The pre-test mean score of the first competency is 3.50 while the post-test is 6.77. The computed t-value is 12.68 which is greater than the critical t-value of 2.01 which led to the rejection of the null hypothesis which means that there is a significant difference between the pre-test and post-test scores of the students on the tests that were conducted.

The second competency mean scores of the pre and post-test vary significantly where the pre-test has a mean of 2.25, and 6.40 for the post-test. The computed t-value of 11.87 is greater than the critical t-value of 2.01 which leads to the decision to reject the null hypothesis and interpretation that there is a significant difference among the tests given to the experimental group.

Lastly, the third competency mean score for the pre-test is 2.37, while for the post-test is 5.06. It has a computed t-value of 11.59 and a critical t-value of 2.01. The decision led to the rejection of the null hypothesis in which there is a significant difference between the pre-test and post-test conducted.

This was supported in the study Using Short Video Lectures to Enhance Mathematics Learning – Experiences on Differential and Integral Calculus Course for Engineering

Students by (Korpele, 2014) this article outlines a strategy for improving math learning that uses brief videos of lectures. The study investigated the students' perspectives on watching videos to learn mathematics.

This is also evident in the study on the Effectiveness of Video Lessons in Improving the Performance of Students in Mathematics 8 (Jerremias & Carretero, 2022) [1]. Results showed that video lessons are useful in all areas of the classroom, and teachers can utilize them to allocate time and space for active learning. This indicates that the student's performance in teaching and learning will increase to higher levels.

In the Study the effects of using video media in mathematics learning on students' cognitive and affective aspects. (Lalian, 2018) [11] the use of videos as a learning media in mathematics plays a role in improving students' motivation to learn, enhancing students' knowledge and understanding of the lesson, and improving the students' achievements. Learning videos, as a medium of learning, have a positive impact on students in the learning process on aspects of cognitive, affective, and psychomotor.

In totality, the overall pre-test has a mean of 8.06, on the other hand, 18.35 is the mean score of the post-test. It has a computed t-value of 15.55 which is greater than the critical t-value of 2.01. Therefore, the null hypothesis is rejected, and is interpreted that there is a significant difference between the conducted pre and post-tests within the experimental group. Thus, the use of videos in teaching measures of central tendency increased the performance of the students.

This is supported in the study Effects of Using Video Lessons in the Mathematics Achievement of Senior High School Learners by Baer (2001) which implies that the use of video lessons are helpful and effective strategy in improving the mathematical skills of the students.

According to the study by Sharma K. (2018) [14], Effects of Instructional Videos and Real-Life Mathematics Activity on Student Achievement and Attitude in a Community College Transitional Mathematics Course to Attract Learners' Attention, integrating videos in classroom teaching has been suggested, and literature supports that instructional videos can accommodate the needs and preferences of young students.

Furthermore, it is evident from the study The Effects of Using Video Media in Mathematics Learning on Students' Cognitive and Affective Aspects by Nau Lalian (2018) [11] that learning videos, as a medium of learning, has a positive impact on students' learning process on aspects of cognitive, affective and psychomotor. The cognitive aspect is the ability to recall and strengthen students' understanding of learning. The effective aspect, through video, can affect students' attitudes and emotions. While the psychomotor aspects, which are difficult to practice can be done repeatedly through individual learning using a learning video. Therefore, students learn more through video-based learning. When students watch videos, not only their auditory skills are enhanced, but also their visual skills.

Significant Difference in the Mean Gain Between the Two Groups

This table presents the significant difference in the mean gain between the controlled and experimental groups.

Table 4: Difference in the Mean Gain of the Two Groups

Groups	Mean Gain	Computed t-value	Critical t-value	Decision	Interpretation
Experimental	10.29	0.510	2.01	Fail to Reject Ho	Not Significant
Controlled	9.85				

The data shows that the mean gain accumulated for the experimental group is 10.29, while the control group has a mean gain of 9.85. The computed t-value is 0.450, which is less than the critical t-value of 2.01. This leads to accepting or failing to reject the null hypothesis which means that there is no significant difference between the mean gain of the experimental and the controlled groups. Though the two groups have different means it is not enough to show that there is a significant difference between their means.

This implies that video-based learning and pure classroom teaching are somewhat comparable to each other since it has only a very slight difference of 0.45 in their mean gain. Both video-based learning and pure classroom discussion brought significant increases in the scores of the students.

The progress of the scores from the experimental and the controlled group during the pre and post-tests that were conducted can be explained by the theory of (Gagne, 1984) in which learning is defined as a change in a person's behavior that is retained and enables a comparable change in that person's conduct in a specific circumstance.

The study The Effect of Implementing Technology in a High School Mathematics Classroom by Murphy, D. (2016) [12] implies that using technology in the classrooms, as the studies suggested, can increase student engagement, increase motivation to learn, allow for better teacher-student interaction, support student collaboration, assist in the accuracy of mathematical computation, and help students not only feel more comfortable with learning mathematics but also allow for a deeper understanding of the mathematical concepts. The positive effect of using technology throughout the curriculum can assist students in learning mathematics to higher-order thinking which can help students even beyond the classroom.

Furthermore, the result of this experimental study is supported by the following studies Effectiveness of Video Lessons in Improving the Performance of the Students in Mathematics 8 (Jerremias & Carretero, 2022) [1], Text-Based Video: The Effectiveness of Learning Math in Higher Education Through Videos and Texts (Ghilay, 2021) [7], Gagne Learning Theory, Effects of Using Video Lessons in the Mathematics Achievement of Senior High School Learners (Baer, 2021) [2], and Effects of Instructional Videos and Real-Life Mathematics Activity on Student Achievement and Attitude in a Community College Transitional Mathematics Course (Sharma K. 2018) [14], The Effects of Using Video Media in Mathematics Learning on Students' Cognitive and Affective Aspects (Lalian, 2018) [11], The Effect of Implementing Technology in a High School Mathematics Classroom (Murphy, 2016) [12], it is evident from the studies conducted that the text, videos, audio or any combination of the modern technologies with the teachers' facilitation are very helpful to the students learning process in Mathematics.

The results of these studies imply that there is insufficient evidence which leads to failure to reject the null hypothesis. It also implies that there is no significant difference between the groups being studied and the variables of the study.

Therefore, the result of the conduct of the experimental study from two different groups - controlled and experimental groups following the identified competencies in measures of central tendency show that they are comparable to each other since both practices are helpful to the students.

Conclusion

It is evident from the study conducted that the use of videos in learning Mathematics and pure classroom teaching facilitated by the teacher are both helpful and effective in improving the mathematical skills of the students.

Video-based instructions aid in the learning process of the students, and students learn best if teachers facilitate the discussion. Video-based instruction offers several advantages. It helps give visual representations, develop learners' engagement, and accessibility of the lesson, develop problem-solving skills, and enhance comprehension and mastery of mathematical concepts. Audio and visual skills of the learners are also enhanced with the aid of videos, students learn more engagingly and interactively. As a result, video-based instruction offers a versatile and effective approach to teaching mathematics with students' diverse learning styles, and it also provides interactive learning experiences.

This study has proven the effectiveness of using both the traditional method of teaching and Instructional Video Materials as ways of learning strategies after utilizing a true experimental research design. Learners (experimental group) who were exposed to Instructional Video Materials exceeded scores in their post-test as well as with the learners who belonged to the controlled group. Deep understanding and usage of learning materials enable learners to learn more effectively and efficiently, especially now in the new generation, wherein more of the students are capable of online gadgets. Instructional Video Materials promote inclusivity by accommodating learners with different learning abilities. Visual learners benefit from the graphics and animations, while auditory learners engage with the spoken explanation.

Traditional and Video Instruction methods are both effective in enhancing the learning ability of the students. Therefore, both methods of teaching are comparable to each other since they showed somewhat similar results after the study had been conducted. On the other hand, students also learn best when the teacher is in front of the students and discussing the lessons.

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