

**Teachers' use of manipulatives in Mathematics 2 instruction:
Utilization, perceived effectiveness, and instructional challenges**

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ABSTRACT

The use of manipulatives provides elementary learners with opportunities to explore mathematical concepts through concrete and meaningful experiences. This study examined the utilization of manipulatives in teaching Mathematics 2 and teachers' perceptions of their effectiveness, challenges, instructional areas requiring enhancement, and recommended strategies in public elementary schools in Quirino District, Isabela, during School Year 2025–2026. A descriptive-normative research design was employed, involving the total population of 25 Mathematics 2 teachers from 19 public elementary schools. Data were gathered through a structured questionnaire supported by interviews and documentary analysis and were analyzed using frequency, percentage, and weighted mean. Findings showed that teachers utilized manipulatives very often across lesson delivery, instructional strategies, classroom management, and teacher readiness, with weighted means ranging from 4.96 to 5.00. Teachers likewise perceived manipulatives as very effective in promoting students' comprehension, engagement, and active participation, with weighted means of 5.00 across these domains. Despite these positive perceptions, teachers identified time constraints, limited professional development, preparation requirements, and resource limitations as important challenges. Teachers strongly agreed that several aspects of manipulative-based instruction require continuous improvement and highly recommended professional development, improved instructional planning, adequate learning resources, classroom management support, and systematic assessment and monitoring. The study recommends sustained institutional support for purposefully integrating manipulatives into elementary mathematics instruction.

Keywords: Mathematics instruction, manipulatives, elementary education, teacher perceptions, Mathematics 2, instructional strategies.

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INTRODUCTION

Mathematics education at the elementary level plays an important role in developing learners' cognitive abilities, logical reasoning, and problem-solving skills. At this stage, pupils begin to construct mathematical ideas that serve as foundations for more advanced learning. However, mathematics instruction that relies heavily on explanation, memorization, and

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symbolic representations may provide limited opportunities for learners to experience mathematical concepts directly. Consequently, instructional approaches that promote active participation and meaningful learning have received increasing attention in mathematics education.

One such approach is the use of manipulatives. Manipulatives are concrete or virtual objects that learners can see, handle, move, and explore while learning mathematical concepts. These may include counters, blocks, tiles, geometric figures, measuring materials, visual representations, and digital or virtual objects. Their use provides learners with opportunities to connect physical experiences with mathematical ideas. Furner and Worrell (2017) emphasized the importance of manipulatives in mathematics instruction because they provide learners with concrete experiences through which mathematical concepts can become more understandable.

The theoretical basis for using manipulatives is consistent with Piaget's theory of cognitive development. Piaget (1969) explained that children progress through developmental stages in which concrete experiences play an important role in the development of more abstract forms of thought. From this perspective, direct interaction with objects can provide young learners with experiences that help bridge physical actions and abstract mathematical representations. Manipulatives may therefore serve as cognitive bridges between what learners can see and handle and the mathematical concepts and symbols they are expected to understand.

Papert (1980) likewise emphasized the educational value of objects that learners can manipulate as tools for constructing knowledge through experience. In mathematics classrooms, such materials allow learners to explore relationships, test ideas, observe patterns, and develop mathematical understanding through active engagement. The use of manipulatives is therefore consistent with constructivist perspectives in which learners actively participate in the construction of knowledge.

The value of manipulatives is also supported by research involving concrete and virtual learning resources. Siller and Ahmad (2024) examined concrete and virtual manipulative blended instruction and highlighted the potential of combining physical and digital representations in mathematics learning. Similarly, Moyer-Packenham and Bolyard (2008) examined the effects of virtual manipulatives on student achievement and mathematics learning, providing a basis for considering digital manipulatives as supplementary resources in mathematics instruction.

Manipulatives may also help learners move from concrete experiences toward more abstract mathematical understanding. Witzel (2005) discussed the Concrete–Representational–Abstract approach as an instructional framework that connects concrete experiences with representational and abstract mathematical understanding. Such an approach is particularly relevant to elementary learners who are developing foundational mathematical concepts.

Research has likewise reported positive contributions of manipulatives to mathematics learning. Carbonneau et al. (2025) synthesized research concerning the effects of manipulatives on mathematics learning and highlighted their potential contribution to mathematical understanding. In addition, Spieckermann (2025) discussed the potential benefits of manipulatives in promoting learner engagement and positive experiences in mathematics. Hand2mind (2025) similarly emphasized the instructional value of manipulatives in helping learners make connections between concrete experiences and mathematical ideas.

The development of virtual manipulatives has further expanded the range of resources available to mathematics teachers. Virtual manipulatives are digital representations that allow learners to interact with mathematical objects through technological platforms. The use of digital manipulatives may provide additional opportunities for exploration and representation, particularly when physical materials are limited. Siller and Ahmad (2024) noted the potential

value of combining concrete and virtual manipulatives within blended instructional environments.

Nevertheless, the effectiveness of manipulatives depends not only on their availability but also on how teachers use them. Manipulatives should be incorporated purposefully into instruction rather than being used merely as objects for pupils to handle. Teachers need appropriate pedagogical knowledge, sufficient preparation time, suitable instructional resources, and classroom management skills to integrate manipulatives effectively into mathematics lessons. The availability and quality of concrete, improvised, visual, and digital resources may likewise influence classroom utilization.

The transition from concrete experiences to abstract mathematical thinking requires purposeful instructional guidance. Teachers need to connect learners' manipulation of objects with mathematical representations, language, reasoning, and problem-solving. Thus, the pedagogical value of manipulatives lies not simply in their presence but in their meaningful integration into the teaching-learning process.

The importance of this issue is particularly evident in elementary mathematics, where learners are still developing foundational mathematical concepts. Manipulatives can provide opportunities for learners to visualize quantities, relationships, operations, and mathematical structures. However, teachers' ability to maximize these opportunities may depend on their preparation, professional development, available resources, and classroom conditions.

In the context of Quirino District, Isabela, examining teachers' actual use of manipulatives is important in understanding how this instructional approach is implemented in Mathematics 2 classrooms. It is equally important to determine how teachers perceive the contribution of manipulatives to pupils' comprehension, engagement, and active participation, as well as the challenges they encounter in their use.

Although previous literature has discussed the potential value of concrete and virtual manipulatives, there remains a need to examine their utilization within specific elementary school contexts. Local conditions such as availability of instructional materials, teachers' preparation, professional development opportunities, classroom conditions, curriculum demands, and school support may influence how manipulatives are used in actual mathematics classrooms.

Thus, this study examined the use of manipulatives in teaching Mathematics 2 in selected public elementary schools in Quirino District, Isabela, during School Year 2025–2026. Specifically, it investigated teachers' utilization of manipulatives, their perceived effectiveness in relation to students' comprehension, engagement, and active participation, the challenges they encountered, the teaching practices requiring enhancement, and the strategies they recommended for strengthening manipulative-based mathematics instruction.

Importantly, the study examined teachers' perceptions of effectiveness rather than directly measuring the causal effect of manipulatives on pupils' mathematical achievement. This distinction is necessary because the descriptive-normative design used in the study does not permit causal conclusions.

Statement of the problem

This study sought to examine the application of manipulatives in teaching Mathematics 2 and their perceived impact on student learning, as observed by teachers in selected elementary schools in Quirino District, Isabela, during School Year 2025–2026.

Specifically, it sought to answer the following questions:

1. What is the demographic profile of the respondents in terms of age, gender, civil status, highest educational attainment, present position, number of years in service, latest performance rating, and level of in-service training attended?
2. To what extent do teachers utilize manipulatives in the instruction of Mathematics 2?
3. How do teachers perceive the effectiveness of manipulatives in terms of students' comprehension, engagement, and active participation?
4. What challenges or limitations are encountered by teachers in incorporating manipulatives into Mathematics 2 lessons?
5. Which aspects of teaching practices involving manipulatives require enhancement according to teachers' perceptions?
6. What recommendations can be formulated to optimize the use of manipulatives in Mathematics 2 instruction and support improved student learning outcomes?

METHODOLOGY

The study employed a descriptive-normative research design. The design was considered appropriate because the investigation focused on describing the prevailing conditions and practices related to the use of manipulatives in Mathematics 2 instruction. Descriptive research is concerned with describing existing conditions, practices, and characteristics of a particular group or setting.

Good and Scates (2001) explained that descriptive methods may be used to determine the current condition of a unit, group, organization, or program. Similarly, Van Dalen and Meyer (1999) described descriptive research as a systematic process of gathering, organizing, analyzing, and interpreting information concerning existing conditions. Best (1999) likewise emphasized that descriptive research describes and interprets conditions or situations under investigation. Whitney (1999) specifically associated descriptive-normative research with determining prevailing or typical conditions.

Consistent with these perspectives, the present study focused on the existing utilization of manipulatives, teachers' perceptions of their effectiveness, challenges encountered in their use, areas requiring improvement, and recommended strategies for Mathematics 2 instruction.

The study was conducted in the public elementary schools in Quirino District, Isabela. Total population sampling was employed. The respondents consisted of 25 elementary school teachers representing 19 public elementary schools in the district.

In terms of age, the largest group of respondents was 36–40 years old, representing 24% of the sample. This was followed by those aged 26–30 years at 20% and those aged 41–45 years at 16%. No respondent belonged to the 20–25 or 61-and-above age groups.

All 25 respondents were female. Regarding civil status, 84% were married, 12% were single, and 4% were widowed.

In terms of educational attainment, 80% had completed master's degree units, 8% were master's degree graduates, and 12% held bachelor's degrees. Regarding position, 80% were Teacher III, 12% were Master Teacher I, and 8% were Teacher I.

The respondents also reported generally high performance ratings. Ninety-six percent had an Outstanding latest performance rating, while 4% had a Very Satisfactory rating.

In terms of length of service, the largest group had 11–15 years of teaching experience, representing 28% of the respondents. This was followed by those with 6–10 years at 24% and those with 21–25 years at 20%. Overall, most respondents had more than 10 years of teaching experience.

Regarding in-service training, 92% reported having attended division-level training, while 8% had attended regional-level training. No respondent reported training at the school, district, national, or international levels.

The primary data-gathering instrument was a structured questionnaire developed from professional books, periodicals, theses, dissertations, and related literature. The instrument consisted of six major parts: the profile of respondents; utilization of manipulatives in Mathematics 2 instruction; perceived effectiveness in students' comprehension, engagement, and active participation; challenges and limitations; teaching practices requiring enhancement; and recommended strategies for optimizing the use of manipulatives.

The questionnaire underwent a try-out among selected public elementary school teachers in the neighboring municipality of Quirino, Isabela. The participants were asked to complete the questionnaire and provide suggestions for improvement. Their comments were considered in revising the instrument. The draft was also presented to the research adviser for additional comments and suggestions before the final questionnaire was reproduced and administered.

Frequency and percentage were used to describe the demographic characteristics of the respondents. Weighted mean was used to determine the extent of utilization, perceived effectiveness, seriousness of challenges, areas requiring improvement, and recommended strategies.

For utilization, weighted mean scores from 4.21 to 5.00 were interpreted as Very Often. For perceived effectiveness, scores within the same range were interpreted as Very Effective. For challenges, scores from 3.41 to 4.20 were interpreted as Serious, while scores from 2.61 to 3.40 were interpreted as Moderately Serious. For teaching practices requiring improvement, scores from 4.21 to 5.00 were interpreted as Strongly Agree. For recommended strategies, scores from 4.21 to 5.00 were interpreted as Highly Recommended.

RESULTS AND DISCUSSION

The findings indicate that teachers utilized manipulatives very often in Mathematics 2 instruction. Across the major dimensions of utilization, weighted mean scores ranged from 4.96 to 5.00, all falling within the Very Often category.

In terms of frequency and purpose, the overall weighted mean was 4.96. Teachers reported using manipulatives very often to help pupils understand abstract mathematical ideas, provide guided practice, and assess learning. Each of these indicators obtained a weighted mean of 5.00. The use of manipulatives when introducing new concepts received a weighted mean of 4.92, while their use for reviewing previously learned lessons received 4.88.

These findings suggest that manipulatives were not limited to the presentation of new mathematical concepts. Teachers also incorporated them into guided practice and assessment, indicating their use across several stages of the instructional process.

With respect to the types of manipulatives used, the overall weighted mean was 4.97, interpreted as Very Often. Visual manipulatives and digital or virtual manipulatives each received a weighted mean of 5.00. Concrete objects, such as counters, blocks, and sticks, and commercially produced manipulatives each obtained 4.96, while improvised or locally available materials received 4.92.

The relatively high use of both visual and digital manipulatives suggests that teachers were incorporating a variety of representations in Mathematics 2 instruction. The findings are relevant to the literature emphasizing the complementary possibilities of concrete and virtual manipulatives (Siller & Ahmad, 2024).

The use of manipulatives in relation to instructional strategies also obtained a very high rating, with an overall weighted mean of 4.99. Four indicators received a weighted mean of 5.00: allowing pupils to manipulate materials individually, encouraging exploration and

discovery, integrating manipulatives with other teaching strategies such as discussion and drills, and using manipulatives to differentiate instruction according to pupils' learning needs. Small-group learning received 4.96.

These results indicate that manipulatives were being used not merely as instructional materials but also as components of learner-centered and differentiated teaching strategies. This is consistent with the view that manipulatives can provide opportunities for active engagement and exploration (Papert, 1980).

Classroom management and instructional application obtained an overall weighted mean of 5.00. All indicators received the highest possible rating. Teachers reported very frequent management of pupils' use of manipulatives, provision of instructions regarding their proper use, and use of manipulatives to support engagement, mathematical understanding, and performance.

Teacher readiness and support likewise obtained a weighted mean of 5.00. The findings indicate that respondents perceived themselves as prepared and confident in incorporating manipulatives into Mathematics 2 instruction.

Overall, the results demonstrate that manipulatives were widely integrated into Mathematics 2 instruction in the participating schools. Their use extended across lesson delivery, instructional strategies, classroom management, learner engagement, and teacher preparation.

Teachers perceived manipulatives as Very Effective in supporting students' comprehension, engagement, and active participation. Each of these three dimensions obtained an overall weighted mean of 5.00.

In terms of comprehension, teachers perceived manipulatives as very effective in helping pupils understand basic mathematical concepts, comprehend abstract ideas, retain lessons, clarify difficult concepts, and develop problem-solving skills. All indicators received a weighted mean of 5.00.

This finding is consistent with the theoretical perspective of Piaget (1969), which emphasizes the importance of concrete experiences in children's cognitive development. It also corresponds with the Concrete–Representational–Abstract approach discussed by Witzel (2005), in which concrete experiences can provide a foundation for representational and abstract understanding.

In terms of engagement, manipulatives were perceived as very effective in increasing pupils' interest, sustaining attention, motivating participation, making lessons enjoyable, and reducing anxiety. Each indicator received a weighted mean of 5.00.

The result is consistent with Spieckermann (2025), who discussed the potential of manipulatives to support learner engagement and positive experiences in mathematics. It also supports the broader view that active interaction with learning materials can create opportunities for learners to participate more meaningfully in the learning process.

In terms of active participation, all five indicators likewise obtained a weighted mean of 5.00. Teachers perceived manipulatives as very effective in encouraging pupils to participate in class discussions, engage in hands-on learning, collaborate with classmates, ask questions and share ideas, and complete Mathematics 2 tasks actively.

The findings are compatible with the perspective of Papert (1980), who emphasized the value of objects that learners can manipulate as tools for constructing knowledge through active interaction and experience.

However, these findings should be interpreted within the methodological limitations of the study. The weighted mean of 5.00 represents the teachers' perceptions of effectiveness and does not constitute direct evidence that manipulatives caused improvements in pupils' academic achievement. The present descriptive-normative study did not employ an

experimental or quasi-experimental design, nor did it directly measure pretest-posttest achievement gains.

Despite the very high utilization and perceived effectiveness of manipulatives, teachers reported several challenges in implementing manipulative-based instruction. The overall weighted mean for the challenges was 2.50, interpreted as Moderately Serious.

The most serious challenges were pressure to complete the Mathematics 2 curriculum within limited time and limited opportunities for professional development related to manipulatives. Both obtained a weighted mean of 3.72.

Insufficient preparation time was also identified as a serious challenge, with a weighted mean of 3.56. The additional effort required to design or improvise manipulatives received a weighted mean of 3.52.

Several challenges were classified as moderately serious. These included the lack of appropriate manipulatives aligned with Mathematics 2 lessons, limited budget for purchasing or producing manipulatives, poor condition or durability of available materials, insufficient availability of manipulatives in schools, lack of administrative support, insufficient class time, and heavy teaching workload. Their weighted means ranged from 2.72 to 3.12.

Other challenges were rated slightly serious or least serious. These included limited training on the effective use of manipulatives, large class size, increased classroom noise, the possibility of pupils misusing or damaging manipulatives, difficulty managing pupils, limited teacher confidence, difficulty maintaining pupils' focus, and difficulty aligning manipulatives with lesson objectives.

The pattern suggests that the most prominent challenges were associated with time, professional development, preparation, and resources rather than resistance to the use of manipulatives. This finding is important because it indicates that strengthening manipulative-based instruction may require institutional and organizational support in addition to individual teacher effort.

The respondents strongly agreed that several aspects of manipulative-based teaching practices require enhancement. The overall weighted mean was 4.98, classified as Strongly Agree.

Fourteen indicators received the highest weighted mean of 5.00. These involved lesson planning, selecting manipulatives aligned with lesson objectives, designing manipulative-based activities, using manipulatives to explain difficult mathematical concepts, classroom management, clarity of instructions, improving pupils' comprehension, assessment practices, time allocation, maintaining pupil focus, evaluating effectiveness, teacher training, teacher collaboration, and reflective practice.

Four other indicators obtained 4.96. These involved improving the use of manipulatives to promote pupil engagement, addressing diverse learning needs, improving the use of improvised or locally available materials, and strengthening the integration of digital or virtual manipulatives.

The use of manipulatives to encourage pupil participation received 4.92, while integration with other teaching strategies received 4.88. Although these values were slightly lower, they remained within the Strongly Agree category.

These results indicate that teachers recognized the need for continuous improvement even though they reported very frequent utilization and very high perceived effectiveness. The findings suggest that effective manipulative-based instruction involves more than simply providing materials. It requires purposeful planning, appropriate selection, activity design, classroom management, assessment, reflection, and alignment with instructional objectives.

Teachers highly recommended several strategies to strengthen the use of manipulatives in Mathematics 2 instruction.

Teacher professional development received an overall weighted mean of 5.00, classified as Highly Recommended. All four proposed measures received a weighted mean of 5.00: regular in-service training on the effective use of manipulatives, workshops on designing manipulative-based learning activities, mentoring or coaching programs, and seminars related to hands-on Mathematics instruction.

The strong emphasis on professional development is consistent with the challenges identified earlier, particularly the limited opportunities for professional development and the need to strengthen teacher skills. It suggests that teachers recognize continuing professional learning as an important condition for sustaining effective manipulative-based instruction.

Instructional planning and strategies likewise received an overall weighted mean of 5.00. Teachers highly recommended preparing daily lesson plans that incorporate manipulatives systematically, developing structured manipulative-based lesson guides, using manipulatives to teach difficult concepts, and combining manipulatives with learner-centered strategies.

Instructional resources and materials also received an overall weighted mean of 5.00. Teachers highly recommended increasing the availability of concrete manipulatives, encouraging the use of improvised or locally available materials, allocating funds for purchasing or developing mathematics manipulatives, and integrating digital or virtual manipulatives into Mathematics 2 instruction.

Classroom management and learning environment received an overall weighted mean of 5.00. Teachers highly recommended providing sufficient instructional time, strengthening classroom management strategies during hands-on activities, establishing clear guidelines for pupils' proper use of manipulatives, and adjusting class organization to support effective manipulative use.

Assessment and monitoring obtained an overall weighted mean of 4.62, also classified as Highly Recommended. Integrating manipulatives into formative and summative assessment, monitoring pupils' learning progress during manipulative-based lessons, and evaluating their effectiveness in improving learning outcomes each received a weighted mean of 4.63. Conducting action research to improve the use of manipulatives received 4.59.

These findings suggest that teachers view manipulative-based instruction as requiring a comprehensive support system that includes professional development, instructional planning, adequate resources, classroom management, assessment, monitoring, and research-based reflection.

The findings have several implications for elementary mathematics instruction.

First, the very high reported utilization of manipulatives indicates that teachers in the participating schools have incorporated hands-on and representational materials into Mathematics 2 teaching. This provides a foundation for strengthening manipulative-based instruction.

Second, the consistently high teacher perceptions of effectiveness suggest that manipulatives are regarded as useful tools for facilitating comprehension, engagement, and active participation. This finding is generally consistent with the literature emphasizing the role of manipulatives in providing concrete learning experiences (Furner & Worrell, 2017; Piaget, 1969).

Third, the challenges identified by teachers indicate that sustained implementation requires institutional support. Time constraints, preparation demands, limited professional development, and resource availability cannot always be addressed by teachers individually.

Fourth, the findings point to the importance of moving beyond the simple presence of manipulatives toward their purposeful pedagogical integration. Manipulatives should be

selected according to the mathematical concept being taught, the developmental needs of pupils, and the intended learning outcomes. Their use should also be connected to questioning, discussion, representation, practice, and assessment.

Finally, the strong recommendation for action research provides an opportunity for teachers to systematically investigate which types of manipulatives, instructional approaches, and classroom conditions are most useful for particular Mathematics 2 competencies. Such inquiry could complement the existing literature on concrete and virtual manipulatives (Moyer-Packenham & Bolyard, 2008; Siller & Ahmad, 2024).

CONCLUSION

The study found that teachers in the participating public elementary schools in Quirino District, Isabela, reported very frequent use of manipulatives in Mathematics 2 instruction. Manipulatives were utilized across different purposes, types, instructional strategies, classroom applications, and aspects of teacher readiness.

Teachers also perceived manipulatives as very effective in supporting students' comprehension, engagement, and active participation. The consistently high ratings indicate strong teacher confidence in the instructional value of manipulatives. Nevertheless, these results represent teacher perceptions and should not be interpreted as direct evidence of a causal effect on student achievement.

Despite the positive findings, teachers identified several challenges, particularly pressure to complete the curriculum within limited time, limited professional development opportunities, preparation requirements, and the additional effort required to design or improvise materials. Resource availability, budget, administrative support, and workload were also identified as relevant concerns.

The teachers further recognized the need to enhance various aspects of manipulative-based instruction, including lesson planning, selection and design of activities, classroom management, assessment, teacher competence, collaboration, reflection, and integration of manipulatives with other instructional approaches.

Overall, the findings indicate that the effective use of manipulatives depends not only on teachers' willingness to use them but also on the availability of appropriate materials, sufficient preparation and instructional time, professional development, classroom management support, and systematic assessment and reflection.

Based on the findings, continuous professional development through training, workshops, seminars, mentoring, and coaching should be provided to strengthen teachers' knowledge and skills in designing and implementing manipulative-based Mathematics 2 lessons.

Teachers should be supported in developing lesson plans and instructional guides that incorporate manipulatives purposefully and align their use with specific learning objectives and learner needs.

Schools should ensure adequate access to concrete, locally improvised, visual, digital, and virtual manipulatives. Appropriate budgetary support should be provided for the acquisition, development, maintenance, and replacement of instructional materials.

School administrators should consider providing adequate instructional time for hands-on mathematics activities and strengthening classroom management strategies that facilitate productive manipulation and collaboration among pupils.

Manipulatives should be integrated into formative and summative assessment where appropriate, and teachers should monitor pupils' learning progress while using these materials.

Finally, teachers are encouraged to conduct action research to determine how particular types of manipulatives and instructional approaches influence learners' mathematical understanding and classroom participation. Further studies involving larger populations, multiple districts, classroom observations, and direct measures of pupil achievement are also recommended.

The study was limited to 25 elementary school teachers from 19 public elementary schools in Quirino District, Isabela, during School Year 2025–2026. The findings therefore describe the perceptions and reported practices of the participating teachers and should not automatically be generalized to other districts or educational contexts.

Another limitation is the reliance on teacher-reported data. Although the questionnaire was supported by interviews and documentary analysis, the study did not directly measure pupils' mathematical achievement through a controlled intervention. Future research may therefore employ quasi-experimental or mixed-methods designs to compare learning outcomes among pupils exposed to different forms of manipulative-based instruction.

Future studies may also investigate the relative effectiveness of concrete, improvised, visual, and virtual manipulatives for specific Mathematics 2 competencies. Classroom observations and learner-level assessments could provide additional evidence concerning how manipulatives influence mathematical reasoning, problem-solving, engagement, and retention.

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