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Exploring the effects of the Concrete–Representational–Abstract Model in teaching Mathematics

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ABSTRACT

The Concrete–Representational–Abstract (CRA) model provides a structured approach to mathematics instruction by moving learners from hands-on experiences to visual representations and, finally, to abstract mathematical symbols. This study examined teachers' perceptions of the implementation and instructional influence of the CRA model in Grade 4 Mathematics. A descriptive-normative research design was used with 87 Grade 4 teachers from public elementary schools. Data were gathered through a questionnaire, unstructured interviews, and documentary analysis. Descriptive statistics, including frequency, percentage, and weighted mean, were used to analyze the data. The findings showed that the CRA model was perceived as fully implemented, with an overall weighted mean of 4.32. Teachers strongly agreed that the model supported pupils' conceptual understanding, engagement and motivation, problem-solving skills, and academic performance. The corresponding weighted means were 4.47, 4.53, 4.42, and 4.45, respectively. Despite these positive perceptions, teachers reported serious challenges involving instructional implementation, time, and availability of materials and resources. Learner-related concerns and limitations in teacher competence and professional support were moderately serious. The findings support continued use of the CRA model, together with stronger instructional resources, professional development, administrative support, and sufficient time for implementation.

Keywords: Concrete–Representational–Abstract model, mathematics instruction, Grade 4 mathematics, conceptual understanding, elementary education.

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INTRODUCTION

Mathematics education remains an important component of elementary education because foundational mathematical knowledge contributes to later academic learning, logical reasoning, and problem-solving. Experiences during the elementary years can also shape learners' understanding of and attitudes toward mathematics. For this reason, mathematics educators have increasingly explored instructional approaches that make mathematical ideas more accessible and meaningful to young learners. Azmi (2025), for example, emphasized the

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practical value of the Concrete–Representational–Abstract (CRA) approach in mathematics learning.

The CRA model provides a structured sequence through which learners move from concrete experiences to visual representations and eventually to abstract mathematical symbols. The approach is consistent with Bruner's (1966) theory of representation, which describes learning through enactive, iconic, and symbolic modes. In the CRA sequence, learners first interact with physical objects. They then represent their experiences through pictures, diagrams, or other visual models. Finally, they use numbers, symbols, and mathematical notation to express and solve problems (Concrete, Representational, Abstract [CRA], n.d.).

The sequence is particularly relevant to elementary mathematics because many mathematical concepts are initially difficult for learners to understand when presented only through symbols. Concrete materials allow learners to see and manipulate quantities and relationships. Representational activities then provide a bridge between physical experiences and mathematical notation. The final abstract stage allows learners to apply these ideas using conventional mathematical symbols and procedures.

Previous studies have reported positive outcomes associated with CRA-based instruction. Research has shown that learners exposed to the CRA sequence performed better in tasks involving mathematical problem solving and the computation of geometric measures. The approach has also been associated with improved conceptual understanding and retention (The effect of using concrete-representational-abstract sequence in teaching the perimeter of geometric shapes for students with learning disabilities, 2022). Similarly, research involving learners at risk for mathematics failure has emphasized the importance of carefully structured transitions between concrete and abstract representations (The effects of the concrete-representational-abstract sequence for students at risk for mathematics failure, 2025).

The value of the approach, however, depends on how it is implemented. The use of CRA requires appropriate materials, sufficient instructional time, well-designed activities, and teachers who understand how to move learners from one stage to another. Research has also pointed to differences in the extent to which CRA is used in actual mathematics classrooms (The extent of use of concrete-representational-abstract [CRA] model in mathematics, 2024). Thus, positive evidence regarding CRA does not necessarily mean that implementation is uniform across schools and classrooms.

The Philippine elementary school context provides an important setting for examining this issue. Mathematics instruction may still rely heavily on symbolic procedures, particularly when teachers face limitations in instructional materials, time, or professional support. These conditions can make it difficult to provide learners with sustained opportunities to work with concrete and representational forms before they encounter abstract notation.

Grade 4 Mathematics is particularly relevant because learners at this level encounter concepts involving fractions, measurement, operations, and problem-solving. These concepts require more than procedural knowledge. Learners need to develop conceptual understanding and the ability to connect mathematical ideas with practical situations. The CRA model may provide a useful instructional bridge for this purpose.

The present study therefore examined the implementation of the CRA model in Grade 4 Mathematics and teachers' perceptions of its instructional influence. It specifically considered its perceived contribution to conceptual understanding, engagement and motivation, problem-solving skills, and academic performance. The study also examined challenges related to instructional practices, time, materials and resources, learner characteristics, teacher competence, and professional support.

METHODOLOGY

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The study employed a descriptive-normative research design. This design was selected because the study sought to describe existing practices and determine teachers' perceptions regarding the implementation and instructional influence of the CRA model.

Descriptive research is concerned with describing existing conditions and practices within a particular group or setting. Good and Scates (2001) explained that descriptive methods may be used to determine the current condition of groups, organizations, programs, and other units of analysis. Van Dalen and Meyer (1999) likewise noted that descriptive research goes beyond simple fact gathering by examining relationships and patterns within existing conditions. Best (1999) described descriptive research as a means of describing and interpreting the conditions under investigation. Whitney (1999) further emphasized its usefulness in identifying prevailing conditions and generating information that can guide practice.

The design was appropriate because the study did not seek to manipulate an intervention or establish a causal relationship experimentally. Instead, it documented the reported implementation of CRA and teachers' perceptions of its instructional influence.

The study was conducted in the public elementary schools under the City Schools Division of Ilagan, Isabela. The study included Grade 4 teachers from the public elementary schools in the city.

Purposive sampling was used to select the respondents. One Grade 4 teacher was selected from each of the 87 public elementary schools included in the study. Thus, the final sample consisted of 87 teacher-respondents. The original study identified the participating schools individually, but these school-by-school details were omitted from the journal version to maintain a concise presentation appropriate for an international research article.

The respondents represented a range of ages and professional backgrounds. The largest age group was 41–45 years, comprising 18 respondents (20.69%). This was followed by the 36–40 and 46–50 age groups, with 16 respondents each (18.39%). Female teachers comprised 69 respondents (79.31%), while male teachers comprised 18 (20.69%). The respondents were generally experienced teachers, and many had postgraduate qualifications or were pursuing further studies.

The main data-gathering instrument was a researcher-developed questionnaire. It was supported by two supplementary sources of information: unstructured interviews and documentary analysis.

The questionnaire contained five parts. The first gathered the respondents' demographic and professional profiles. The second assessed the level of CRA implementation in Grade 4 Mathematics. The third examined teachers' perceptions of the instructional influence of CRA on pupils' learning. The fourth focused on challenges encountered during implementation. The fifth solicited recommendations for improving CRA implementation.

The questionnaire was developed from professional books, periodicals, theses, dissertations, and other relevant materials. It was tried out among selected teachers in the nearby municipality of Gamu, Isabela. Feedback from the tryout and the research adviser was incorporated into the final version before its administration.

Unstructured interviews were conducted to clarify selected responses. Interviews were held during respondents' vacant periods or recess, while some were conducted during home visits. Documentary analysis was also used to verify selected information obtained through the questionnaire.

Permission to conduct the study was obtained from the Office of the Schools Division Superintendent and the administrators of the participating schools. After the questionnaire had

been revised, the researcher personally distributed and retrieved the instruments from the respondents.

The completed questionnaires were tallied and organized for analysis. Interview responses and relevant school records were used to supplement and check selected questionnaire responses.

Frequency and percentage were used to describe the respondents' profiles. Weighted means were used to summarize responses concerning CRA implementation, its perceived instructional influence, challenges, and proposed improvements.

For implementation, a weighted mean of 4.21–5.00 was interpreted as Fully Implemented, 3.41–4.20 as Implemented, 2.61–3.40 as Moderately Implemented, 1.81–2.60 as Slightly Implemented, and 1.00–1.80 as Least Implemented.

For perceived instructional influence, weighted means of 4.21–5.00 indicated Strongly Agree, while lower ranges represented progressively weaker levels of agreement. For challenges, the corresponding ranges were interpreted from Very Serious to Least Serious. These interpretations followed the scoring system used in the original study.

RESULTS AND DISCUSSION

The 87 respondents were predominantly female, with women accounting for 79.31% of the sample. The largest age group was 41–45 years old (20.69%), followed by those aged 36–40 and 46–50 years (18.39% each). Teachers aged 31–35 comprised 14.94%, while those aged 26–30 and 51–55 each represented 10.34%. Only 2.30% belonged to each of the 20–25, 56–60, and 61-and-above groups.

The respondents were generally experienced teachers. Most had postgraduate qualifications or were pursuing further studies. The findings also indicated that professional development was more commonly obtained at the divisional level, while exposure to national and international training was limited.

These characteristics suggest that the respondents had substantial classroom experience. Their perceptions of CRA implementation were therefore based largely on their professional experience in Grade 4 Mathematics instruction.

Implementation of the CRA Model

The teachers perceived the CRA model as fully implemented, with an overall weighted mean of 4.32.

The strongest area of implementation involved the use of representational or pictorial activities, such as drawing, modeling, and diagramming, which obtained a weighted mean of 4.49. This was followed by the proper sequencing of concrete, representational, and abstract activities (4.37).

The introduction of abstract symbols, numbers, and equations after concrete and representational activities received a weighted mean of 4.34. Assessment activities aligned with the three CRA stages also obtained 4.34.

The use of concrete materials, such as manipulatives and real objects, received a weighted mean of 4.33. Using CRA to support pupils' understanding of mathematical concepts and addressing diverse learning abilities each received 4.32. Integrating CRA into daily Mathematics 4 lesson plans received 4.31, while providing opportunities for pupils to manipulate concrete materials before moving to pictorial representations and planning the transition from concrete to representational activities each received 4.29.

Allocating sufficient instructional time for the CRA sequence received 4.21. The lowest-rated implementation indicator concerned school support, including instructional

materials, training, and supervision, which received 4.17. Although this remained within the "Implemented" category, it was lower than the other indicators.

Overall, the findings indicate that teachers reported substantial use of all three CRA stages. The relatively lower rating for school support suggests that implementation depended considerably on classroom-level practices rather than on uniformly strong institutional support.

Teachers strongly agreed that CRA contributed to pupils' conceptual understanding, with an overall weighted mean of 4.47.

The highest-rated indicator was the perception that CRA helped pupils develop a clear understanding of basic mathematical concepts (4.54). Teachers also strongly agreed that pupils demonstrated improved comprehension when instruction began with concrete materials before moving to abstract symbols (4.51).

The use of manipulatives to reduce mathematical misconceptions received a weighted mean of 4.44. Teachers also agreed strongly that pupils could explain mathematical ideas more accurately following CRA-based instruction (4.40).

These findings suggest that teachers viewed the movement from concrete experience to representation and abstraction as particularly useful in helping pupils develop mathematical meaning.

Teachers also reported a strongly positive perception of CRA's influence on pupils' engagement and motivation. The overall weighted mean was 4.53.

The highest-rated indicator was increased pupil interest in Mathematics lessons when CRA was used (4.57). The use of visual and hands-on activities to motivate pupils obtained 4.54. Active pupil participation received 4.53, while increased confidence in solving mathematical problems received 4.49.

The results indicate that teachers associated CRA with greater participation and interest. The hands-on and visual elements of the model appeared to make Mathematics lessons more engaging from the teachers' perspective.

The overall weighted mean for problem-solving skills was 4.42, interpreted as strongly agree.

Teachers most strongly agreed that pupils became better able to apply learned mathematical concepts to real-life situations after CRA-based instruction (4.46). Improved logical reasoning in solving Mathematics problems received 4.43.

The perception that CRA improved pupils' ability to solve mathematical problems independently received 4.40, while the transition from representational to abstract learning as a means of strengthening problem-solving strategies received 4.39.

These results suggest that teachers viewed CRA as more than a means of teaching mathematical procedures. They perceived it as supporting the application and transfer of mathematical knowledge.

Teachers strongly agreed that CRA positively influenced pupils' academic performance. The overall weighted mean was 4.45.

The highest-rated statement concerned improved performance in Mathematics 4 assessments when CRA was consistently applied (4.48). Teachers also strongly agreed that CRA helped pupils retain mathematical concepts for longer periods (4.45) and contributed positively to overall Mathematics 4 achievement (4.45). Improved accuracy in mathematical computations received 4.44.

Although these findings reflect teacher perceptions rather than independently measured achievement gains, they indicate a strong belief among respondents that CRA contributed to pupils' academic outcomes.

The overall assessment of CRA's instructional effectiveness produced a weighted mean of 4.47, interpreted as strongly agree.

Teachers strongly agreed that they would recommend CRA to other elementary Mathematics teachers (4.52). They also agreed that CRA helped them address diverse learning needs (4.47) and was suitable for pupils with varying levels of mathematical ability (4.45). Its effectiveness for teaching Mathematics 4 concepts received 4.44.

The results therefore indicate broad teacher support for CRA as an instructional approach, particularly in relation to adaptability and inclusiveness.

Despite the positive assessments, teachers identified several challenges.

Instructional and pedagogical challenges were rated serious, with an overall weighted mean of 3.43. The most serious concern was difficulty in helping pupils transition from concrete and representational activities to abstract mathematical concepts (3.48). Designing lesson plans that followed the CRA sequence was the second most serious concern (3.45). Teachers also reported difficulty implementing all three stages within one class period (3.43). Difficulty aligning CRA activities with prescribed Mathematics 4 competencies was comparatively less serious (3.34) but remained a concern. The results highlight an important issue in CRA implementation. Moving learners through the three stages requires more than simply providing manipulatives or pictures. Teachers must also determine when and how learners are ready to move toward abstraction.

Time-related challenges were rated serious, with an overall weighted mean of 3.51. The most serious concern was the time required to prepare materials and activities for CRA lessons (3.66). Teachers also reported insufficient instructional time to implement CRA effectively (3.52) and difficulty completing CRA activities within limited class periods (3.52).

Disruption of Mathematics lesson pacing received a lower weighted mean of 3.33, interpreted as moderately serious. The findings indicate that time is a practical constraint on full CRA implementation. The model requires preparation and sufficient classroom time for learners to engage with each stage.

Challenges involving materials and resources were also rated serious, with an overall weighted mean of 3.45. The most serious concern was the lack of adequate concrete manipulatives (3.54). Dependence on improvised or self-made materials followed (3.51). Limited instructional resources for the representational stage received 3.49. Inadequate school support in providing materials received 3.25, which was classified as moderately serious.

The findings suggest that teachers often compensate for resource limitations through improvisation. While this demonstrates teacher initiative, sustained implementation may require more systematic provision of CRA materials.

Learner-related challenges were rated moderately serious, with an overall weighted mean of 3.33. Variation in pupils' learning abilities received the highest rating (3.38). Difficulty transitioning from hands-on activities to abstract symbols followed (3.34). Difficulty understanding mathematical concepts even with CRA instruction received 3.32, while classroom management during hands-on activities received 3.28. These findings indicate that CRA does not eliminate learner differences. Teachers still need to adjust instruction according to pupils' readiness, comprehension, and ability to make connections between representations.

Challenges involving teacher competence and professional support were also rated moderately serious, with an overall weighted mean of 3.38. Insufficient training in CRA implementation was the most serious concern (3.44), followed by limited professional development opportunities related to CRA-based instruction (3.41). Lack of instructional guidance or mentoring received 3.37, while limited teacher collaboration in sharing CRA strategies received 3.30. These findings point to the importance of sustained professional learning. Initial exposure to the CRA model may not be sufficient for teachers to develop

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confidence in lesson planning, classroom management, material selection, and the transition to abstraction.

The respondents generally agreed with the proposed measures for strengthening CRA implementation. The overall weighted mean was 3.92. The highest-rated recommendation was the provision of CRA-aligned lesson guides and exemplars (4.03). Making visual and representational materials readily available ranked second (4.02). Active administrative support ranked third (4.00), followed by the development of a centralized resource bank (3.99). Providing sufficient instructional time, considering class size during hands-on activities, and using teacher feedback to improve implementation each received 3.97. Explicitly including CRA in the Mathematics 4 curriculum received 3.94. Other recommendations included adjusting class schedules, conducting regular in-service training, providing workshops on lesson planning and classroom strategies, allocating budgets for CRA materials, including CRA indicators in classroom observations, encouraging teacher collaboration, incorporating CRA discussions into Learning Action Cells, and conducting regular monitoring and evaluation. Mentoring or coaching received the lowest weighted mean among the recommendations (3.79), although it remained within the "Agree" category.

Discussion

The findings showed that teachers perceived the CRA model as widely implemented in Grade 4 Mathematics. The overall implementation rating of 4.32 suggests that teachers were regularly using concrete materials, representational activities, and abstract mathematical symbols. This pattern is consistent with the theoretical basis of CRA and Bruner's (1966) view that learners can progress from action and experience toward visual and symbolic representation.

The particularly high rating for representational activities is notable. The representational stage functions as a bridge between physical manipulation and abstract mathematical notation. Flores et al. (2014) demonstrated the usefulness of the CRA sequence in teaching mathematical operations, particularly when learners need structured support in moving toward symbolic procedures. The current findings similarly suggest that teachers recognized the value of maintaining a progression rather than introducing mathematical symbols immediately.

Teachers' strong agreement regarding conceptual understanding also supports the central premise of CRA. The highest rating in this area concerned pupils' development of clearer understanding of mathematical concepts. This finding is consistent with research showing that concrete and representational experiences can help learners establish meaning before they encounter formal mathematical notation (The effect of using concrete-representational-abstract sequence in teaching the perimeter of geometric shapes for students with learning disabilities, 2022).

The strong rating for engagement and motivation is also important. Mathematics instruction that involves manipulation, visualization, and active participation may provide learners with more opportunities to interact with mathematical ideas. The present findings suggest that teachers perceived these features as contributing to pupils' interest and participation.

Similarly, teachers reported strong positive perceptions regarding problem solving. The highest-rated problem-solving indicator involved applying mathematical concepts to real-life situations. This finding is consistent with the broader view of mathematical competence presented by the National Research Council (2001), which emphasized that mathematical

proficiency involves more than knowing procedures. Learners must also understand concepts and apply mathematical knowledge appropriately.

The findings concerning academic performance require more careful interpretation. Teachers strongly agreed that CRA improved pupils' performance and retention. However, the study measured teachers' perceptions rather than pupils' achievement through an experimental or quasi-experimental comparison. Therefore, the results support the conclusion that teachers perceived positive academic effects, but they do not independently establish that CRA caused measurable gains in achievement.

The study also revealed that effective implementation was accompanied by substantial practical challenges. The most important instructional problem was helping learners move from concrete and representational experiences to abstraction. This is a central issue in CRA instruction. The three stages are not merely separate activities. They are intended to form a coherent progression toward increasingly abstract mathematical thinking.

Time was another major constraint. Teachers reported difficulty preparing materials and completing all three stages within a class period. This finding is important because CRA requires planning and sequencing. If classroom time is insufficient, teachers may shorten one stage or move prematurely to abstract procedures.

Material availability also emerged as a serious concern. Concrete manipulatives and representational resources are central to the model. Their absence can therefore limit implementation. Teachers' reliance on improvised materials shows resourcefulness but may also add preparation demands.

The findings concerning professional support further reinforce the need for continuing teacher development. Insufficient CRA-related training was the highest-rated concern within this area. Van de Walle et al. (2019) emphasized the importance of instructional approaches that support mathematical understanding rather than relying solely on procedural teaching. For CRA to achieve this purpose, teachers need practical knowledge of how to design tasks, select representations, assess understanding, and determine when learners are ready to move toward abstraction.

The recommendations respondents identified align closely with these challenges. Lesson guides, instructional materials, administrative support, resource banks, sufficient time, and professional development were among the highest-rated measures. These recommendations indicate that improving CRA implementation should not rest entirely on individual teachers. School-level and system-level support are also necessary.

CONCLUSION

The study found that the CRA model was perceived by Grade 4 teachers as fully implemented in Mathematics instruction. Teachers strongly perceived the model as beneficial to pupils' conceptual understanding, engagement and motivation, problem-solving skills, and academic performance. They also considered CRA appropriate for learners with varying mathematical abilities and expressed willingness to recommend its use to other elementary Mathematics teachers.

At the same time, implementation was not without difficulties. Teachers reported serious concerns involving instructional and pedagogical demands, time, and the availability of materials and resources. Learner-related concerns and limitations in teacher competence and professional support were moderately serious. The most prominent instructional concern was the transition from concrete and representational experiences to abstract mathematical thinking.

Taken together, the findings suggest that the potential value of CRA depends not only on teachers' willingness to use the model but also on the conditions surrounding its implementation. Adequate materials, sufficient instructional time, practical lesson guides,

administrative support, and continuing professional development are necessary to strengthen classroom implementation.

Because the study relied primarily on teachers' perceptions, the positive findings concerning pupil outcomes should be interpreted cautiously. Future research could complement teacher perceptions with direct measures of pupil achievement, classroom observations, and experimental or quasi-experimental designs. Such studies could provide stronger evidence regarding the effect of CRA on mathematical learning.

The findings have several implications for elementary mathematics instruction. First, schools should provide teachers with CRA-aligned lesson guides and exemplars that demonstrate how concrete, representational, and abstract activities can be connected within a single lesson or sequence of lessons.

Second, schools should improve access to concrete manipulatives and representational materials. A centralized resource bank could reduce teachers' need to prepare or improvise materials individually.

Third, school administrators should provide institutional support through instructional supervision, resource allocation, and appropriate scheduling. CRA activities require sufficient time, particularly when learners need opportunities to explore and discuss representations before moving to symbolic procedures.

Finally, professional development should focus on the practical challenges identified in the study. Training should address lesson planning, selection of representations, classroom management during hands-on activities, assessment across the three CRA stages, and strategies for helping learners make the transition to abstraction.

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