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DIDACTIC GAMES IN SECOND-GRADE MATHEMATICS TEACHING: A CLASSROOM CASE STUDY

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Abstract. This article examines the use of didactic games in second-grade mathematics teaching, with particular attention to learning motivation and the teacher's role in structuring a supportive learning environment. The theoretical section reviews literature on motivation, active learning, and didactic games. The empirical section reports a classroom case study conducted at Hinko Smrekar Primary School with 22 second-grade students over an eight-week period. Mathematics achievement was assessed using comparable pre- and post-intervention tests, while motivation was examined using a five-point self-assessment scale and structured classroom observation. Mean mathematics achievement increased from 68% to 84%, and mean self-reported motivation increased from 3.1 to 4.3 on a five-point scale. The findings suggest that carefully structured didactic games may support active participation, motivation, and the consolidation of mathematical knowledge. Given the single-class case-study design, the findings should be interpreted as context-specific descriptive evidence rather than as causal proof of effectiveness.

Key words: didactic games, mathematics achievement, learning motivation, active learning, primary education.

1. Introduction

Mathematics can be challenging for many students, particularly in the early years of primary education, when learners begin to engage with increasingly abstract concepts and symbolic representations. Instruction at this stage should therefore support conceptual understanding while also sustaining students' willingness to participate and persist. Play is a developmentally appropriate context for young learners because it allows them to explore, test ideas, receive feedback, and learn through experience.

This article has two aims: first, to outline theoretical perspectives on learning motivation and didactic games; and second, to present a classroom case study of their systematic use in second-grade mathematics teaching. The case study links concrete examples of instructional games with descriptive pre- and post-intervention indicators of mathematics achievement and student motivation.

Accordingly, the empirical component addresses two descriptive questions: (1) How did students' mathematics achievement change after eight weeks of systematic use of didactic games? (2) How did students' self-reported motivation and observed classroom engagement change over the same period?

Theoretical Background

Motivation is a key condition for successful learning because it influences students' willingness to engage in learning activities, persist when tasks become difficult, and work toward learning goals. Marentič Požarnik (1980) describes motivation as a set of internal and external factors that direct individual behaviour. For younger learners, intrinsic motivation is particularly relevant because curiosity, interest, and enjoyment can sustain engagement with learning tasks.

Research and theoretical work on active and playful learning suggest that young learners benefit when they can explore ideas and participate meaningfully in the learning process. Bruner's (1966) framework of discovery learning emphasizes active engagement and guided exploration. More recent evidence has refined this perspective by stressing the value of guided, rather than entirely unstructured play. In a systematic review and meta-analysis, Skene et al. (2022) found that guided play showed advantages over direct instruction for some early learning outcomes, including early mathematics skills and shape knowledge. These findings underline the importance of purposeful adult guidance while preserving children's active participation and agency.

In mathematics specifically, Ramani and Siegler (2008) found that playing numerical board games produced broad and stable improvements in young children's numerical knowledge. Contemporary syntheses provide further, but appropriately qualified, support for game-based approaches. Pan, Ke, and Xu (2022), in a systematic review of 43 studies in K-12 mathematics education, emphasized that learning outcomes depend on how mathematical content is integrated with game mechanics and instructional design. Hui and Mahmud (2023) reported generally positive findings across cognitive and affective outcomes, including mathematical knowledge, skills, achievement, motivation, interest, and engagement. Particularly relevant to the present study, Russo et al. (2024) reviewed non-digital mathematical games in primary education and found generally positive effects on mathematical proficiencies and dispositions, while noting that the evidence base is concentrated mainly on number and operations. Taken together, recent research supports the use of games as a potentially valuable instructional approach, but not as an automatically effective one: their educational value depends on alignment with explicit mathematical objectives, appropriate challenge, guidance, and opportunities for reflection.

Although teachers cannot directly create motivation in another person, they can shape the conditions under which motivation is more likely to develop. Their role includes deliberate planning, establishing a supportive classroom climate, and adapting learning activities to students' prior knowledge. More demanding tasks can be divided into manageable steps so that students experience progress and are able to participate successfully. Variety in teaching methods and forms of work can further support active involvement.

Teachers should also set realistic and attainable goals and provide specific, constructive feedback that encourages persistence. Referring students to previous progress can strengthen their sense of competence and confidence. Games and other creative activities can contribute to a positive emotional climate by making practice more engaging and less monotonous (Macuh, 2009).

Within this broader set of instructional strategies, didactic games can be incorporated at different stages of a lesson: for introducing a concept, practicing procedures, consolidating knowledge, or checking understanding. Their educational value depends on the extent to which the game structure, rules, and required actions are meaningfully connected to the intended learning outcomes. The following discussion therefore focuses on didactic games as planned instructional activities rather than on play used solely for entertainment.

Play is a fundamental activity in children's development and learning (Marjanovič Umek & Zupančič, 2006; Trček, 2010). In school settings, didactic games are distinguished from free play by the presence of clearly defined educational purposes and didactic-methodological tasks (Kocjančič, 2002). Their rules, content, and sequence are deliberately

structured to support learning and development (Pečjak, 2009). From the student's perspective, however, the educational purpose need not dominate the experience; the activity should still retain the engaging and voluntary qualities associated with play.

Depending on their design, didactic games can support the development of cognitive, social, linguistic, creative, and motor skills. They may also create opportunities for students to practice independence, perseverance, cooperation, problem solving, generalization, and memory in interaction with peers (Klemen, 2010). These broader benefits are most educationally relevant when they complement, rather than replace, clearly specified subject-specific learning goals.

A didactic game can be understood as a dynamic teaching method in which students participate actively, interact with peers, and construct knowledge through guided activity (Mrak Merhar, Umek, Jemec, & Rupnik, 2013). Because the game is used as a means of achieving instructional objectives, the teacher must plan its content, rules, level of difficulty, and organization in relation to the lesson goals (Tomić, 2002). At the same time, the activity should preserve essential characteristics of play; otherwise, students may experience it simply as another exercise presented in game-like form (Bognar, 1987).

A well-designed didactic game has clear content, structure, and tasks. Solving these tasks requires an appropriate level of cognitive effort and provides students with immediate opportunities to test their understanding. For the teacher, students' responses during the game can also provide formative information about misconceptions, procedural fluency, and the extent to which the intended objectives have been achieved (Tomić, 2002).

Using didactic games for consolidation can make repeated practice more varied and meaningful. Students can revisit mathematical content in a context that requires decision making, interaction, and immediate responses, while also developing logical thinking. When the challenge level is appropriate, such activities can reduce the sense of routine associated with repeated practice and can help maintain attention and engagement (Trček, 2010). Games can offer important opportunities for learning and development (Umek et al., 2013), but their use in classroom instruction also creates practical demands. Teachers must invest time in planning, preparing materials, explaining rules, organizing groups, and connecting the activity to the curriculum. Students, meanwhile, may initially perceive a game primarily as entertainment rather than as a learning task. This makes careful framing and follow-up essential (Štuhica, 2009).

The effectiveness of a didactic game depends on several design conditions. Tasks should take account of students' developmental level and prior knowledge while still requiring meaningful cognitive effort. Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD) offers a useful framework for this balance. The ZPD refers to the range between what a learner can accomplish independently and what the learner can accomplish with guidance from an adult or in collaboration with a more capable peer. In didactic games, this means that tasks can be set slightly beyond students' current independent performance, provided that appropriate scaffolding is available through teacher prompts, questioning, modelling, hints, or peer support. As competence develops, this support can be gradually reduced. Tasks that are far beyond students' reach may produce frustration, whereas tasks that are already fully mastered may provide insufficient cognitive challenge. Group size also matters: in groups that are too large, some students may participate only minimally, weakening both learning opportunities and motivation.

Another design consideration is the balance between knowledge, skill, and chance. Including an element of randomness can allow less academically successful students to experience success and remain engaged, provided that chance does not replace the mathematical thinking required by the task. After the game, feedback and brief reflection are important: the teacher should discuss strategies, errors, and insights with students and explicitly reconnect the activity to the mathematical content (Štupica, 2009). The game structure itself must therefore remain aligned with the intended learning objectives (Bognar, 1987).

Didactic value does not arise from the presence of a game format alone. Educational benefits are more likely when games are carefully planned, clearly structured, developmentally appropriate, and actively guided by the teacher. In this sense, a didactic game combines elements of play with systematic practice directed toward explicit learning goals (Bognar, 1987).

Case Study at Hinko Smrekar Primary School

Research Design and Participants

The empirical component used a one-group classroom case-study design with 22 second-grade students at Hinko Smrekar Primary School. Didactic games were systematically incorporated into mathematics lessons over an eight-week period. The activities focused on curriculum content that included addition and subtraction up to 100, place value (tens and ones), and numerical magnitude relationships.

Measures and Analysis

Mathematics achievement was assessed before and after the eight-week period using comparable tests covering addition and subtraction up to 100, place value, and numerical magnitude relationships. Student motivation was assessed using a brief self-assessment scale ranging from 1 (lowest) to 5 (highest) and was complemented by structured classroom observation.

The analysis is descriptive. The article reports class-level mean percentages, percentage-point changes, and mean motivation ratings. Observational evidence is summarized qualitatively in terms of persistence, participation in group activities, and avoidance behaviour during mathematical problem solving. Given the one-group case-study design, the results are interpreted as classroom-level indicators rather than as causal estimates.

Intervention Activities

The following games were selected to align with specific mathematical objectives and to combine repeated practice with active participation. They were used during the eight-week intervention and were adapted to the developmental level of the students.

Game: HIT THE TARGET

Materials:

- a box,
- a ball,
- cards with numbers,
- an hourglass timer.

Objectives:

- ordering numbers by size up to 100,
- creating arithmetic expressions using given numbers up to 100,
- identifying tens and ones in a given number.

Game description:

Students work in small groups. Their goal is to collect as many cards as possible within the allotted time. To earn a card, a student places one foot on a card and then attempts to throw a ball into the box. If the throw is successful, the student keeps the card; if it is unsuccessful, the card remains in play and the next group member takes a turn.

When the allotted time has elapsed, the teacher assigns a mathematical task that students complete using the cards they have collected (e.g., ordering numbers, forming arithmetic expressions, or identifying tens and ones). Each group also receives three blank 'joker' cards on which students may write missing numbers when necessary. This feature adds flexibility and encourages group members to plan and cooperate.



Figure 1: *Hit the Target* game. Author's own work

Game: FLY SWATTER
Materials:

- flies with numerical values,
- fly swatters,
- cards with arithmetic problems and written solutions.

Objectives:

- calculating up to 20 with regrouping (carrying/borrowing).

Game description:

Students work in small groups and distribute the arithmetic-problem cards among themselves. One student acts as the reader and reads a problem aloud. The correct solution is printed on the card so that the reader can verify the response. The remaining students calculate mentally, locate the fly showing the correct answer, and try to be the first to tap it with a fly swatter.

The activity is designed to support active participation, rapid mental calculation, and immediate verification of results while providing varied practice with basic arithmetic.



Figure 2: *Fly Swatter* game. Author's own work

Game: MATHEMATICAL BINGO
Materials:

- a game board,
- cards with arithmetic problems,
- bottle caps (or markers).

Objectives:

- adding and subtracting tens (e.g., 23 + 20),
- adding and subtracting ones (e.g., 34 + 3),
- calculating up to 100 without regrouping.

Game description:

Within each group, students select a leader who draws and reads the arithmetic problems aloud. The remaining students receive a game board and markers. After hearing a problem, students write it down, calculate the result, and look for the corresponding number on their board. If the result appears, they cover it with a marker.
The activity is designed to support calculation accuracy, independent checking of results, and active participation while reinforcing basic arithmetic operations in a playful format.



Figure 3: *Mathematical Bingo* game. Author's own work

Game: FISHING
Materials:

- "sea" (a blue mat),
- fish with paper clips,
- a fishing rod (a stick with a string attached, a cork float, and a magnet).

Objectives:

- calculating up to 20,
- understanding numerical magnitude relationships up to 100,
- identifying the predecessor and successor of a given number up to 100,
- identifying tens and ones in a given number.

Game description:
Students take turns using the fishing rod to catch a fish from the 'sea.' The colour of the fish determines the type of mathematical task the student completes. After responding, the student passes the fishing rod to the next group member.
Tasks according to fish colour are as follows:

- **green fish** – the student identifies the given number,
- **blue fish** – the student solves an arithmetic problem up to 100,
- **orange fish** – the student identifies the number of tens and ones in the given number.

The activity provides varied practice with mathematical content and is designed to support cooperation, independence, concentration, and enjoyment of learning.



Figure 4: *Fishing* game. Author's own work

Game: ACTIVE MATHEMATICS
Materials:

- cards with tasks (arithmetic problems, numbers, etc.),
- a worksheet on which students record their answers.

Objectives:

- identifying tens and ones,
- calculating up to 20 and up to 100.

Game description:

Cards marked with symbols are placed at different locations around the classroom. A mathematical task, such as 13 + 3, is written on the reverse side of each card. Each student receives a worksheet containing symbols that correspond to the cards.

The student's task is to find a symbol shown on the worksheet. After locating the matching card, the student turns it over, reads and memorizes the task, and returns to their seat. The student then writes the problem next to the corresponding symbol on the worksheet and calculates the solution.

The activity is designed to combine physical movement with mathematical practice while supporting concentration, memory, and independent work.



Figures 5 and 6: *Active Mathematics* game. Author's own work

Results

The descriptive pre- and post-intervention comparison showed improvement in both mathematics achievement and self-reported motivation at the class level. Because the study reports aggregated outcomes from a single class, the values below are presented as descriptive indicators.

Mathematics Achievement

- Mean score before the intervention: 68%
- Mean score after the intervention: 84%
- Change in mean score: +16 percentage points

Performance on place-value tasks showed the largest reported increase, from 61% accuracy before the intervention to 82% after it, a gain of 21 percentage points.

Student Motivation

- Mean self-reported motivation before the intervention: 3.1/5
- Mean self-reported motivation after the intervention: 4.3/5

Structured classroom observations also indicated greater persistence, more frequent participation in group activities, and less avoidance during mathematical problem-solving tasks over the intervention period.

Taken together, the descriptive results show a positive pattern during the period in which didactic games were systematically used. However, the study design does not allow the observed changes to be attributed exclusively to the intervention.

Discussion and Limitations

The observed increase in class-level mathematics achievement is consistent with prior work on numerical board games (Ramani & Siegler, 2008) and with more recent systematic reviews of game-based mathematics learning (Pan et al., 2022; Hui & Mahmud, 2023; Russo et al., 2024). The latter review is especially relevant because it focuses on non-digital games in primary mathematics and reports generally positive outcomes across mathematical proficiencies and dispositions. The improvement in the present case study was particularly marked for place value, suggesting that repeated, concrete practice within the games may have helped students consolidate representations of tens and ones. This interpretation is also consistent with the emphasis in recent reviews on aligning game mechanics with the mathematical content being learned. Because the present study did not isolate the effects of individual games or include a comparison group, however, this interpretation remains tentative.

The increase in self-reported motivation, together with observations of greater persistence and participation, is compatible with Self-Determination Theory, which emphasizes the motivational relevance of autonomy, competence, and relatedness (Ryan & Deci, 2020). These psychological needs were not measured directly in the present study; the theory is therefore used as an interpretive framework rather than as a tested explanatory mechanism.

Several limitations restrict the conclusions that can be drawn. The case study involved a single class of 22 students and used a one-group pre-post design without a comparison group. The article reports class-level aggregate outcomes, and the brief motivation scale and structured observation are not described as standardized measures. Practice effects, maturation, ongoing instruction, and teacher expectations may therefore have contributed to the observed changes. Future studies should include larger and more diverse samples, comparison conditions, validated measures, individual-level analyses, and delayed follow-up assessments of retention.

Despite these limitations, the case study has practical value because it documents concrete, curriculum-aligned activities that can be integrated into everyday second-grade mathematics teaching. The examples illustrate how game mechanics, movement, peer interaction, and immediate feedback can be combined with explicit learning objectives.

Conclusion

This classroom case study suggests that didactic games can be a useful component of second-grade mathematics instruction when they are deliberately aligned with learning objectives and followed by feedback and reflection.

Over the eight-week implementation period, the class mean on mathematics tests increased from 68% to 84%, while mean self-reported motivation increased from 3.1 to 4.3 on a five-point scale. Structured observations also indicated greater persistence and participation. These descriptive changes are encouraging, but they should not be interpreted as proof that the games alone caused the improvement.

For classroom practice, the key implication is not simply to add games to lessons, but to design them around specific mathematical content, an appropriate level of challenge, meaningful student participation, and clear opportunities to discuss strategies and errors.
When these conditions are met, didactic games can complement other instructional approaches by providing repeated practice in an active and socially engaging format that is appropriate for young learners.

Further research with stronger comparative designs is needed to determine the size, durability, and generalizability of the observed effects. Within the limits of the present case study, the findings support the continued, systematic, and critically reflective use of didactic games in primary mathematics teaching.

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