More Than Fun and Games: Teaching Mathematics Through Games

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Mathematical games are valued for fostering engagement, fluency, and conceptual understanding. While research often focuses on student outcomes, less is known about how teachers plan and implement game-based instruction. This study addresses that gap by examining the beliefs, motivations, and practices of five primary teachers using educationally rich games. Based on teacher interviews and observations, the study explores how frequently games are used, their purposes, and how classroom enactments align with the pedagogical potential described in the literature. Findings show substantial variation. Although all teachers reported using games to support learning, only two consistently enacted them to promote reasoning, discussion, and deep conceptual engagement. The others used games mainly for fluency and motivation, often emphasising accuracy in fact retrieval over mathematical thinking. The study underscores the need for intentional planning and facilitation to harness the full educational potential of games. It argues that access to well-designed games are not enough; their impact depends on how they are used.

Keywords • mathematics teacher education research • mathematical games • conceptual understanding • reasoning

Introduction

Game-based learning in mathematics has gained considerable attention for its potential to engage students, promote fluency, and support conceptual understanding. Most of the research, however, has focussed on digital games and student outcomes, with comparatively little attention given to the role of teachers in planning, implementing, and facilitating these experiences. A recent systematic review by Russo et al. (2024) found that of 32 empirical studies on non-digital game-based learning in primary mathematics classrooms, 25 focused exclusively on students, six included students and teachers, and only one focused solely on teachers. As Russo and colleagues noted, "the voices of teachers are significantly under-represented in the research" (p. 16). This is a critical oversight, as teachers are the ones making key instructional decisions, selecting appropriate games, adapting them to meet student needs, and guiding interactions and discussion during and following gameplay. Without a deeper understanding of teachers' instructional choices, knowledge of game-based learning remains incomplete.

This study addresses this gap by investigating the beliefs, motivations, planning, and facilitating practices of five primary school teachers as they implemented a set of research-informed mathematical games in their classrooms. Specifically, it explores how teachers use games as instructional tools: how frequently they use them, for what purposes, and how they plan and implement game-based lessons. It also examines teachers' perceptions of the mathematical potential of the games they choose and whether they view these games as supporting the proficiencies associated with working mathematically, such as fluency, understanding, problem-solving, reasoning, and fostering positive dispositions toward mathematics and playing games.

To better understand these instructional decisions, it is important to examine how mathematical games are currently used in primary classrooms and why teachers use them. This paper narrows its focus to explore how teachers' beliefs, decisions, and classroom practices shape their use of mathematical games. The research questions guiding this study are:

1. *How do teachers' beliefs and motivations shape their use of mathematical games in the classroom?*
2. *How do teachers' implementation of game-based lessons reflect or differ from the pedagogical potential of games as teaching environments?*

Literature Review

To investigate how these claims about game use play out in classrooms, it is essential to begin by examining how frequently teachers report using games and for what instructional purposes. Understanding these patterns helps ground the study in the realities of classroom practice and sets the stage for exploring how beliefs, motivations, and contextual factors shape game selection and use.

Well-designed Mathematical Games

In this study, *mathematical games* are understood as structured, rule-based activities in which mathematical ideas are integral to gameplay. They involve meaningful choice, strategic decision-making, and player interaction, ensuring that success depends on engaging with the underlying mathematics rather than on chance alone (Gough, 1999; Russo et al., 2023; Russo & Russo, 2025). As Gough (1999) argued, a true mathematical game requires at least two players who take turns, make decisions, and influence one another's moves, distinguishing genuine games from game-like activities such as drills, races, or bingo-style tasks that rely purely on chance or repetition. Well-designed mathematical games embed core concepts within the game mechanics, balancing skill, strategy, and chance to maintain cognitive demand while fostering reasoning, fluency, and reflection (Nurnberger-Haag et al., 2023; Russo & Russo, 2025). From this perspective, mathematical games function not merely as tools for practice or motivation, but as rich mathematical tasks that can simultaneously develop understanding, problem-solving, fluency, and reasoning.

Frequency and Purpose of Games

Mathematical games are widely used in primary classrooms. Although many authors highlight their popularity and frequent use (e.g., Bragg, 2007; Heshmati et al., 2018; Swan & Marshall, 2009), relatively little empirical research has investigated how often games are implemented in practice. Russo et al. (2021) offered one of the few studies on this topic, reporting that over three-quarters of Australian primary school teachers surveyed use games multiple times per week, primarily non-digital formats such as dice and cards, due to their accessibility and ease of classroom integration. Most commonly, games are used to support fluency practice, particularly arithmetic skills and number facts (Bragg, 2007; Godfrey & Stone, 2013; Russo et al., 2021; Swan & Marshall, 2009). As Bragg (2007) noted, games are often seen as engaging alternatives to more traditional forms of repetitive practice.

Despite some teachers reporting that games support conceptual understanding and reasoning (Russo et al., 2021), multiple studies suggest that games are rarely used to introduce new ideas in practice. Instead, they are typically positioned as warm-ups, closures, or rewards (Afari et al., 2013; Bragg, 2007; Swan & Marshall, 2009), reinforcing their supplementary role. Even when learning goals include conceptual understanding, implementation often relies on behaviourist approaches, such as drill, repetition, and factual recall, rather than on inquiry or discussion (Kacmaz & Dubé, 2022).

While Ernest (1986) envisioned games as central to mathematics instruction, his perspective was part of a longer tradition of using games to teach mathematical concepts. Earlier scholars such as Dienes (1963) and Skemp (1978) had already advanced this view, emphasising that mathematical understanding develops through exploration, manipulation, and reasoning rather than procedural practice. Dienes promoted learning by doing and student-centred play, using games to help children experience and generalise mathematical structures. Skemp's distinction between instrumental and relational understanding echoed this focus on conceptual rather than procedural learning. Despite this long-standing recognition of the pedagogical potential of games, contemporary classroom practice often reflects a narrower focus, with games frequently used to build fluency or maintain engagement rather than to foster reasoning or conceptual insight. The literature has consistently called for the deliberate use of games as pedagogical tools to support understanding of mathematical ideas (Clarke & Roche, 2010; Heshmati et al., 2018; McFeetors & Palfy, 2018; Nurnberger-Haag et al., 2023; Russo et al., 2023; Swan & Marshall, 2009). This study investigates whether current uses of games in primary mathematics classrooms reflect these foundational visions or whether their deeper conceptual potential remains under-utilised.

Investigating Motivation to Understand Different Teacher Approaches

While frequency and purpose are central to understanding game-based instruction, teacher motivation provides crucial insight into how games are presented and used. For decades, games have been recognised for both their motivational appeal and pedagogical potential (Bright et al., 1983; Ernest, 1986; Gough, 1999; Russo et al., 2021). These authors argued that games not only engage learners but also support the development of conceptual understanding, cooperation, and problem-solving; benefits that continue to resonate with teachers today.

In a survey of 248 Australian primary school teachers, Russo et al. (2021) found that 82% strongly agreed that games are an effective way to engage students, reaffirming the long-standing appeal of games as motivational tools (Attard, 2012; Bragg, 2007). Engagement alone, however, was not the primary driver of specific game use. Most teachers emphasised the importance of aligning games chosen with specific mathematical learning objectives, reinforcing Ernest's (1986) call for purposeful selection and curriculum integration.

Teachers in Russo et al.'s (2021) study also highlighted a range of additional motivations when selecting games, including their adaptability for differentiation, cited by over half of the respondents. Many described modifying rules, adjusting complexity, or altering student group structures to accommodate diverse learning needs and promote equitable participation. For just under half of the teachers, classroom management was a key consideration. Preferred games offered a structured, student-directed activity that could be smoothly integrated into lesson routines, such as warm-ups, early finisher tasks, or transitions. Enjoyment was identified by over a third of teachers as a valuable factor, with particular games chosen to maintain student attention, promote positive attitudes toward mathematics, and foster a lively, low-stakes learning environment. Some teachers also identified broader benefits. Games were seen as a means of strengthening home-school connections when sent home for practice. These findings reflect a broad pedagogical orientation that balances learning goals with practical concerns related to differentiation, engagement, and classroom flow. Collectively, these motivations reveal a pedagogical stance toward game use that values purposeful mathematics instruction and considers the pragmatic realities of classroom teaching.

Despite these benefits, only 10% of teachers cited reasoning or mathematical dialogue as a reason for playing a particular game, and just 5% reported selecting games to facilitate open-ended investigation (Russo et al., 2021). This reflects a broader pattern observed in the literature—a persistent gap between the pedagogical potential of games and their classroom use (Kacmaz & Dubé, 2022), particularly when used as platforms for open-ended mathematical inquiry and exploration.

While many teachers intend to use games for learning, these intentions are not always fully realised in practice. Heshmati et al. (2018) found that the quality of mathematical thinking during gameplay depends not only on game design but also on how the teacher frames and facilitates the activity. In their analysis of two fraction games (*Cover-up* and *Un-cover*), most teacher–student talk focused on rules and turn-taking rather than mathematical reasoning. High-quality interactions that made student thinking visible were significantly less frequent than in comparable non-game instruction. These findings suggest that effective implementation, not just game design, is critical if games are to support conceptual understanding rather than remain procedural or motivational activities. As Heshmati et al. (2018) argued, more research is needed to understand how the design and classroom use of mathematical games influence the kinds of mathematical thinking students engage in during gameplay. Likewise, Russo et al. (2021) highlighted the need for clearer guidance around selecting and using games effectively, especially given the substantial instructional time many teachers already dedicate to playing them. Drawing on classroom-based research, Russo and colleagues (2023; 2025) recommended that teachers select games that explicitly connect gameplay to mathematical learning goals, maintain conceptual focus throughout play, and include structured opportunities for reflection and discussion. Building on this work, the present study examined how five teachers enacted these principles in practice, exploring how their motivations and instructional choices shaped the ways games were presented and used in their classrooms.

Methodology

The following section introduces the schools and teachers involved in the study. While not the primary focus of analysis, these contextual details offer an important background for understanding the diversity of teaching experience and classroom environments in which the game-based lessons were enacted.

Participants and Setting

This study was conducted in two Victorian state schools with contrasting socio-economic profiles. One school served a disadvantaged community, while the other was situated in a higher socio-economic area. Five Year 3/4 teachers and approximately 90 students participated. Pseudonyms have been used to protect the teacher participants' confidentiality. Ashleigh, Morgan, and Ryan taught at School 1, while Emily and Joel were based at School 2. The five teacher participants varied in teaching experience: Ryan, Emily, and Joel were in the early stages of their careers, each with less than five years of experience; Morgan had been teaching for over 20 years; and Ashleigh had more than 25 years of experience and held the role of mathematics leader at her school.

Research Design

This study employed a qualitative, descriptive case approach (cite methodology literature here) to examine how five primary school teachers planned for and implemented a set of research-informed mathematical games. Teachers were introduced to five games, each carefully selected based on research into well-designed mathematical games (Russo et al., 2023; Russo & Russo, 2025). During a planning meeting, they played each game and were supported with resources, including:

- A short practitioner article outlining the game and offering classroom implementation ideas;
- A PowerPoint presentation explaining the rules for each of the games; and
- An analysis linking each game to curriculum outcomes and the mathematical proficiencies. These proficiencies: Understanding, Fluency, Problem-solving, and Reasoning, were drawn from the *Australian Curriculum: Mathematics* (Australian Curriculum, Assessment and Reporting Authority, 2022).

Each teacher selected two multiplication games from a curated collection of carefully designed, non-digital games (see Appendix 1). For each game chosen, teachers taught two lessons: the first using a one-against-one (1v1) format; the second in a pair-based (2v2) format. Lessons were conducted during regular class periods, each lasting approximately 47 minutes. All five games were purposefully adapted for both formats and designed in accordance with educationally rich game principles that emphasise strategic decision-making, mathematical reasoning, and reflective discussion (Russo et al., 2023; Russo & Russo, 2025). Although these grouping strategies shaped how students interacted with the games, the current article focuses on teacher decision-making rather than gameplay format. The researcher observed gameplay across two consecutive lessons in each classroom, enabling comparative analysis of their beliefs, planning choices, and enactment decisions. One game, *Reverse Land Grab* (Russo & Russo, 2021), emerged as a common choice among four of the participants, making it a useful focal point for analysing how instructional intent shapes game implementation.

An Example of a Game Used in the Study: Reverse Land Grab

Reverse Land Grab is a strategic game designed to deepen understanding of area, multiplication, and number structure. In Reverse Land Grab, Students roll a single multi-sided die (e.g., a 20-sided die) to determine the area they must attempt to claim on the grid (e.g., a roll of 18 requires the player to enclose 18 squares). The player must then select a pair of factors for the rolled number (e.g., 6 × 3 or 9 × 2 for 18) and draw a rectangle with those dimensions that fits within the remaining unclaimed space on the board. If a player rolls a number for which no rectangle can be placed within the available space (for example, if the number is prime [e.g., 13] and a 1 × n rectangle will not fit, or if the remaining space is too constrained), the player forfeits a turn. Play continues until no further rectangles can be placed on the board. The winner is the player who has claimed the greatest number of squares. As the board progressively fills, the demands for both spatial reasoning and numerical reasoning increase, as players must consider multiple factor pairs and available board configurations when deciding where to place their rectangles. The game supports conceptual understanding by exploring arrays, factors, prime numbers, square numbers, and the commutative property of multiplication. Students develop fluency through repeated application of multiplication facts and flexible number decomposition. The game fosters problem-solving as players navigate limited space constraints and make strategic placement decisions. Reasoning is embedded in the gameplay as students justify their choices and reflect on efficiency, space usage, and number properties.

Reverse Land Grab was selected purposefully because it aligns with all four mathematical proficiencies (Table 1; ACARA, 2022) and exemplifies Russo and Russo (2025) design principles of well-designed mathematical games. The design principles include strategic agency, where students must make purposeful decisions to influence outcomes; embedded representation, where core mathematical concepts (e.g., factors and arrays) are structurally woven into the game mechanics; and opportunities for reflection, where gameplay prompts students to justify decisions and make connections. Mathematics remains central, decisions matter, and the game offers a balance of skill and chance. It can be adapted to suit different learners and is useful for mathematical investigations, for example, exploring why some numbers have more rectangular representations or how prime numbers present strategic challenges (Table 2).

Table 1
Alignment of Reverse Land Grab *with Mathematical Proficiencies*

Mathematical Proficiencies	Focus in the Game
Understanding	Composite numbers have multiple factor pairs (arrays), whereas prime numbers have only one (1 × *n*). Factors divide a number with no remainder. In this game, the factors are represented by the length and width of the rectangles drawn on the grid.
Fluency	Develops fluency and flexibility with multiplication facts through visual representation of arrays.
Problem solving	Requires identifying all possible rectangles for a given product and selecting the best fit within the grid's spatial constraints.
Reasoning	Involves justifying choices, recognising constraints, and making generalisations about factors, primes, and grid size.

Table 2

Alignment of Reverse Land Grab *with Russo & Russo's (2025) Design Principles for Well-designed Mathematical Game*

Design Principles	How it is Evident in Reverse Land Grab?
Strategic Agency	Players must make purposeful decisions about which factor pairs to use and where to place rectangles to maximise their claimed area while limiting opponents' options. Each move requires strategic trade-offs between efficiency and space.
Embedded Representation	The mathematical structure of factors and arrays is built into the gameplay: each roll generates a product that must be expressed as a rectangle. Players physically represent multiplication through area models, making number structure visible.
Opportunities for Reflection	The game encourages students to justify and generalise: they explain choices, compare strategies, and explore why primes limit options. Post-game discussion links gameplay to factorisation and multiplicative reasoning.
Mathematics Centrality	The core mathematical content—factors, arrays, area, and prime/composite structure—is integral to progress and success; chance (dice roll) introduces variation but does not replace mathematical reasoning.
Balance of Skill and Chance	Dice introduce uncertainty, ensuring accessibility and excitement, but strategic reasoning determines outcomes. Skilled players use number knowledge to capitalise on favourable rolls.
Adaptability and Extension	The game can be modified for different levels by changing grid size or dice range and extended into investigations (e.g., exploring factor density, efficiency of shapes, or prime number behaviour).

Data Collection and Analysis

To better understand the teachers' instructional choices, semi-structured interviews (Bryman, 2016) were conducted at three key points in the study. An interview protocol guided these conversations (see Appendix 2):

- Pre-interviews explored teachers' existing beliefs, prior experiences with mathematical games, and their planning approaches. These interviews typically lasted approximately 30 minutes.
- Debrief interviews, conducted after each game-based lesson, captured immediate reflections and in-the-moment instructional decisions. These interviews typically lasted approximately 15 minutes.
- Post-interviews examined any shifts in thinking and gathered broader reflections on the experience of implementing the games in their classrooms. These interviews typically lasted approximately 30 minutes.

The use of open-ended questions allowed participants to respond in their own words without being constrained by fixed response options (Bryman, 2016). This approach also provided the researcher with flexibility to adapt to individual responses, reiterate questions as needed, and seek clarification or elaboration when appropriate. All interviews were audio-recorded and transcribed prior to analysis. The interviews provided rich insights into how teachers selected and implemented games in their classrooms and what they learned from the experience.

Interview transcripts were analysed using thematic analysis following the procedures outlined by Braun and Clarke (2006). All interview transcripts (pre-, post-, and debrief) were read multiple times to build familiarity with the data. Initial categories were generated flexibly, focusing on recurring ideas related to teacher beliefs, planning practices, instructional choices, and connections to mathematical proficiencies (see Table 1). These recurring ideas were then organised into key analytical categories that reflected both emerging insights and the study's conceptual aims. Results from the five teachers' interviews and other data were compared to identify similarities and differences. This approach supported a holistic understanding of how mathematical games were conceptualised, planned for, and implemented.

Findings

The following section is organised around five key analytic categories that shaped the study:

(1) teachers' beliefs about the role of games;
(2) the instructional purposes games served in practice;
(3) rationales behind game selection;
(4) planning approaches; and
(5) reflections on the pedagogical potential of games.

These categories were informed by both emergent insights and the study's guiding research question. Within each category, illustrative examples from teacher participants highlight similarities and differences in how mathematical games were conceptualised, planned, and enacted.

Teachers' Beliefs About the Role of Games in Mathematics Instruction

A core finding of this study relates to the diversity of beliefs teachers hold about the pedagogical role of games in the mathematics classroom. Notably, Ashleigh and Morgan viewed games as rich, multi-purpose tools serving a broad range of outcomes: supporting fluency, fostering understanding, encouraging reasoning and strategic thinking, and promoting positive gameplay dispositions. Ashleigh summarised this view succinctly: "Games can be used for many purposes." She elaborated:

> I use games for fluency, like to practice multiplication facts, for example. But some games you can use for strategy rather than just fluency. So, you want them to be thinking about particular numbers (e.g., prime numbers). The games we're going to be doing next week focus more on strategy and understanding that some numbers are more useful in certain contexts than others.

Morgan similarly described her students "doing a lot of investigating" during gameplay, indicating her belief that games offer opportunities for students to explore and construct mathematical ideas. This approach presents games as important activities for rich mathematical learning.

In contrast, Emily and Joel conveyed games as primarily a way to reinforce previously taught content and support number fluency. Their frequent use of games, up to three or four times weekly, reflected a commitment to engagement and repetition. Still, the purpose of games remained largely consistent: games serve as warm-ups or short activities to consolidate learning. Emily explained that she might "play a game just as a quick review," typically embedding it within a rotation of table-based activities. Joel similarly emphasised using games "mainly for fluency and practice," often sticking to familiar games during warm-ups to focus on key number facts such as multiplication tables. He was explicit about his stance: "Using a game to instruct? Probably not." For Emily and Joel, games were motivational tools that support fluency development rather than as vehicles for introducing new mathematical ideas or prompting deeper exploration.

Ryan's application occupied an interesting middle ground. The games used in his school were typically conceptually focused and therefore played as "once-off" experiences, designed to introduce or deepen understanding of specific mathematical ideas rather than for repeated fluency practice. While his use of games was infrequent, consistent with his school's instructional model, his beliefs aligned more closely with Joel and Emily. He viewed games primarily as tools for fluency development and preferred to use them more regularly, noting that "students become proficient with practice and more time."

The way Ashleigh and Morgan justified their use of games for teaching distinguished them from the other teachers. Although Emily and Joel used games far more often, sometimes almost daily, game use tended to be brief and peripheral, often applied as warm-ups or consolidation tasks. Ashleigh and Morgan, by contrast, used games less frequently but treated them as the lesson itself, carefully connecting the features of games to key mathematical concepts.

Ashleigh and Morgan's beliefs stand out because they framed games as powerful instructional tools capable of supporting rich mathematical learning. For them, games were not just a way to maintain student interest in mathematics but a deliberate pedagogical choice that could support understanding of mathematical ideas. As shown in subsequent sections, these beliefs closely align with how Ashleigh and Morgan selected and implemented games during the current study. Their views suggest that what matters most is not how often games are used, but why they are used, purposefully as tools for teaching mathematical ideas, carefully chosen to match curriculum goals and build fluency in meaningful ways.

Instructional Purposes Assigned to Games

Table 3 summarises the full range of reasons teachers gave for using mathematical games, based on pedagogical considerations. These include learning-related outcomes aligned with the four mathematical proficiencies of fluency, understanding, reasoning and problem-solving, as well as additional factors such as positive dispositions, fun, competition, assessment, and school-home partnerships.

Table 3
Teachers' Reported Reasons for Using Mathematical Games Linked to Mathematical Proficiencies and Broader Motivations

Mathematical Proficiencies and Other Motivations	Themes	Teachers				
		Ashleigh	Emily	Joel	Morgan	Ryan
Fluency	Games are useful for reinforcing or practicing arithmetical skills, such as multiplication facts, skip counting, or two-digit addition, by focusing on number fluency.	✓	✓	✓	✓	✓
Understanding	Games are useful for building conceptual understanding around important mathematical ideas.	✓			✓	
Problem-solving	Games provide an opportunity for students to think strategically and problem-solve.	✓		✓	✓	
Reasoning	Games provide an opportunity to enhance mathematical dialogue, student reasoning, and language development.	✓	✓		✓	
Other Motivations	Games provide an opportunity for students to collaborate, interact, and learn how to play with others (positive gameplay dispositions).	✓			✓	✓
	Games are fun and engaging.	✓	✓	✓	✓	✓
	Games provide an opportunity for students to compete against one another.					✓
	Games are useful for assessment.			✓		
	Games are useful in developing the school-home partnership.	✓				✓

All teachers agreed that games are inherently engaging and can boost student motivation. Ashleigh commented, "They're fun, really engaging, so the students are interested and learning." Ryan echoed this, wanting to incorporate games more often and believing they make practice more enjoyable. Emily and Morgan noted that students often do not even realise they are learning because they are so absorbed in play. Joel said simply, "They are fun, and kids love them." While all teachers viewed engagement as a strength of games, only Ashleigh and Morgan described using engagement as a pathway to deeper mathematical learning. For Joel, Emily, and, to some extent, Ryan, engagement appeared to be an end in itself, valued for maintaining attention and enthusiasm, but not always linked to the development of mathematical understanding. Ashleigh and Morgan's reflections revealed a different relationship between fun and learning. For them, enjoyment was not the goal of the game but the entry point into meaningful mathematical inquiry.

Fluency

All five teachers acknowledged that games are effective tools for practising number facts and building fluency; however, they differed in how they used them. Joel, Ryan, and Emily described using games primarily to make repetitive practice more enjoyable. Emily explained, "The kids are just having fun; they don't see it as boring, like sitting down with their math book." Joel explained that the main benefit was keeping students engaged, adding, "Who doesn't like to play a game?" By contrast, Ashleigh and Morgan described games as more than just tools for fluency but as opportunities for conceptual exploration. These two teachers used gameplay to consolidate skills while deepening students' thinking about mathematical ideas.

Understanding

The contrast among the teachers' beliefs about how games support understanding was apparent. Joel was cautious about using games for instruction, stating that students "need to have all the tools [referring to the fluency demands] to use the game," stating that games should follow instruction, not be a medium for constructing ideas. Conversely, Ashleigh and Morgan embraced games as sites for exploration. Ashleigh noted, "They help children to understand concepts." When asked to provide an example of a game she liked, Ashleigh highlighted "*Colour in Fractions*" (Clarke & Roche, 2011), which she found valuable for teaching concepts such as equivalence, improper fractions, and the addition of fractions. She explained:

> Colour in Fractions *is a terrific game that you can use again and again and get something more out of it each time. I would use it every year as standard, making sure it was a core part of our maths curriculum, certainly, in the Grades five and six.*

In contrast, Emily described a fractions game that required students to match cards to their equivalent fractions, a game aimed at reinforcing previously taught content rather than encouraging exploration. While presented as a game, this task more closely resembled a practice-drill exercise, essentially a "Find the Matching Pairs" activity, in which students located equivalent fractions from a shuffled deck of cards. The randomisation provided by shuffling did not alter the fundamentally repetitive nature of the task; it remained comparable to a worksheet-based matching exercise rather than a true mathematical game. As Gough (1999) noted, genuine mathematical games require players to make strategic choices and respond to one another's moves, ensuring that success depends on engaging with mathematical ideas. By this definition, the activity lacked the strategic agency, conceptual focus, and player interaction that characterise well-designed mathematical games. Ashleigh and Morgan viewed gameplay as an opportunity to develop conceptual understanding, whereas Joel and Emily saw games as follow-up activities used primarily to practice skills already introduced through instruction.

Reasoning

In the Australian Curriculum, mathematical reasoning involves explaining one's thinking, justifying strategies, and evaluating others' ideas (ACARA, 2026). These processes are often expressed through classroom discussions, where students articulate their thinking and respond to peers' reasoning. Ashleigh, Emily, and Morgan all described using games to support students' mathematical reasoning through opportunities to explain and discuss their thinking. Given that both schools in the study had a large population of English language learners, it was unsurprising that language development was also identified as a benefit. The teachers, however, differed in their descriptions of the role of discussion in supporting reasoning.

Emily focused on students explaining how they arrived at an answer. In her classroom, discussion appeared to function primarily as a way for students to articulate their procedures and confirm the correctness of their solutions. Emily explained that she used "games a lot to get them to verbalise to each other how they arrived at a certain answer, rather than just saying, 'I don't know,' or 'I just did it in my head.'" She added, "It takes a little bit of pressure off them trying to explain how they got an answer ... whereas I feel like maybe for them, there's not that pressure explaining to other kids."

By contrast, Ashleigh and Morgan described gameplay as creating opportunities for students to reason collaboratively about mathematical ideas. Ashleigh said, "Playing games gives them a chance to talk to each other and really talk about the mathematics," as they explored different approaches and tested ideas. Morgan similarly explained that it took "the emphasis off teacher talk; the kids are doing a lot of investigating, chatting to each other about the maths, not me showing them." Her comment highlighted how gameplay created opportunities for students to take ownership of mathematical discussion, explaining their thinking, negotiating strategies, and clarifying ideas with peers.

For Emily, the discussion among students appeared to support procedural explanation and accountability. In contrast, Ashleigh and Morgan described it as a mechanism through which students explored and refined mathematical ideas together. In their accounts, discussion was not simply a by-product of gameplay but a central part of students' reasoning about mathematics.

Problem-solving

Ashleigh, Morgan, and Joel believed that games could support problem-solving, though their emphasis differed. Joel associated problem-solving mainly with strategy-based games such as *Nim*, where players must plan moves ahead to win. Joel acknowledged this potential, saying that he used "games for problem-solving too, but mainly for fluency and practice." Morgan, however, saw problem-solving as a chance for students to think aloud, share reasoning, and learn from each other's strategies. She explained that games encouraged students to "strategise and share those strategies when playing," helping them make decisions and reflect on outcomes. For Morgan and Ashleigh, problem-solving through games meant working out why certain strategies worked, recognising patterns, and connecting these discoveries to broader mathematical ideas, rather than simply practising number facts.

Other motivations

Ashleigh, Morgan, and Ryan discussed the value of games for developing students' interpersonal skills, such as cooperation, turn-taking, and respectful competition. Ashleigh explained, "We know that's going to help all of them in the long run. If they can just get along and cooperate with anybody, they've got those skills." Morgan and Ryan also raised challenges related to fairness, reinforcing that games can serve a dual purpose, supporting mathematical and social-emotional learning.

While all five teachers agreed that games are fun and engaging, only Ashleigh and Morgan consistently described using this aspect to deepen mathematical thinking. For Joel, Emily, and Ryan, games were used more often and frequently as warm-ups or practice activities, with limited attention to inquiry or reasoning. Ashleigh and Morgan framed games as vehicles for exploration, reasoning, and dialogue, and integrated them more intentionally into their planning. Interestingly, these differences in beliefs were not always reflected in the frequency of use: Ashleigh and Morgan used games less frequently but with greater instructional intent. These distinctions shaped how games were selected, implemented, and reflected upon, differences that are explored further in the next section.

Game Selection Rationales: Why Most Teachers Chose Reverse Land Grab

Although teachers were free to select any two of the five games introduced in the study, four out of five chose *Reverse Land Grab*, making it an ideal case for examining how the same task can be used in different ways, depending on teachers' intentions.

All teachers selected games according to the belief that games should serve specific instructional goals. Joel stated that games must be "a good fit with specific learning objectives," a view echoed by Ashleigh and Morgan. Morgan explained that "you can't just do a maths game for the sake of playing a maths game" and that "they have to be purposeful." Ashleigh similarly reflected that "it's not always a game that's going to help get to the objective that I'm wanting to teach or achieve." These comments suggest that all participants valued alignment between game choice and learning intentions.

At the same time, Morgan highlighted a key challenge: the difficulty of finding suitable games. She noted, "You've really got to choose an appropriate game, which I try to do, but do I know a great bank of games? Probably not, you know, just what other people show me, so there are some limitations there." What is particularly revealing about the selection of *Reverse Land Grab* is the diversity in how teachers interpreted its purpose.

Joel and Emily: Focus on fluency and engagement

Joel and Emily selected *Reverse Land Grab* primarily for its ability to make multiplication practice more engaging. Joel explained:

> *I like that game too because I think it was easy to differentiate … You can revert it back to the paddocks game … because [some students] are probably not at that stage of looking at the answer and going back.*

His comments focused on making the game accessible and adaptable, not necessarily on its potential for deeper learning. Emily offered a similar rationale, suggesting that "both games had a focus on the strategies that I wanted the kids to work on for multiplication tables." Neither teacher described the game's potential to explore mathematical ideas such as factors, prime numbers, or the properties of arrays. Instead, they framed the game as a more enjoyable way to practise multiplication facts.

Ashleigh and Morgan: Using fluency to build conceptual understanding

By contrast, Ashleigh and Morgan selected *Reverse Land Grab* because they saw it as offering fluency practice and opportunities to explore mathematical ideas. Ashleigh said:

> *I've chosen both games for understanding factors and multiples and products. I realise that all the games could be used for a lot of different things, but I've chosen to use these two games because I can see a real link to a representation (the array gameboard) that's going to help them make sense of multiplication.*

Morgan echoed this perspective, explaining:

> *In the process of learning that some numbers have lots of factors, some don't, like primes, the children will practise multiplication facts. You essentially have to think of the factors for that number … I never found the original Land Grab game challenging … no thinking involved.*

In this view, the game was not just a way to make practice more enjoyable; it was chosen specifically to provoke reasoning about number structure and multiplicative relationships. Ashleigh added:

> *I'm hoping that they will have a better understanding of how to represent multiplication facts using arrays, that they will be able to use the language of multiplication more confidently, and that they'll have some understanding that multiplication can be represented as an area model, that they'll be introduced to prime numbers.*

Although Joel acknowledged that the game could support reasoning, saying students were "thinking about … is it a composite number or is it a prime number?" He also noted that he "didn't expect the kids to have those concepts" and was not "too fussed about whether they understood them or not." These comments highlight the distinction between recognising a game's potential and intentionally designing instruction to draw out that potential. While Ashleigh and Morgan deliberately used *Reverse Land Grab* to support conceptual understanding, Joel and Emily treated it primarily as a fluency tool.

The importance of the instructional purpose

Although *Reverse Land Grab* was designed to support reasoning, strategic thinking, and rich discussion, each teacher's view of the purpose of the game shaped how the game was played. Ashleigh and Morgan saw the game as a platform for introducing mathematical ideas such as factors, primes, and array structures. Joel and Emily used it more as a structured way to revise known content, without focusing on the underlying mathematical ideas.

This contrast suggests that a game's educational value depends not only on its design but also on how teachers frame and implement it. Even a thoughtfully designed game may lead to surface-level learning if its conceptual richness is not intentionally foregrounded.

Having examined teachers' varying reasons for selecting *Reverse Land Grab*, the next section explores how they prepared to implement it. Differences in planning, such as whether teachers used provided resources or anticipated opportunities for mathematical discussion, further reveal how teachers' intentions translated into practice.

Approaches to Planning for Game-based Lessons

The teachers' planning choices closely reflected their beliefs about the purpose of games. Ashleigh and Morgan, who saw games as vehicles for conceptual learning, approached planning with clear intent. They engaged deeply with the provided resources, using them to clarify learning goals, anticipate student thinking, and design questions to prompt discussion. Morgan said, "I think having access to the research about the game … helped me. I was able to say, great, I should ask a question about that,' when I started planning." She also noted the value of preparation, "I'm already thinking that I'm going to play the game myself first … we don't always do that, but I definitely think it's worth doing."

This reflection highlights the importance of teachers building firsthand familiarity with a game before introducing it to students. Even though all teachers had opportunities to play during the planning meeting, Morgan's comments suggested that replaying the game independently helped her see more deeply how mathematical ideas emerged through the rules and mechanics. For example, in *Reverse Land Grab*, recognising the difference between prime and composite numbers only becomes meaningful when players notice that certain numbers cannot be arranged into rectangular arrays. Actively playing and reflecting on this experience enabled teachers like Morgan to anticipate students' misconceptions and plan questions that would prompt reasoning rather than just promote procedural play.

In contrast, Joel and Emily focused more on gameplay mechanics than on drawing out mathematical ideas. Joel admitted, "I read the instructions, but I didn't go through anything else you gave us," while Emily reflected, "Actually playing it during the workshop was what really helped." Although both had played during the planning meeting, neither engaged with the supporting research or lesson-planning materials designed to connect gameplay to conceptual learning. Their approach suggests a more limited preparation process, focused on understanding the rules rather than exploring the mathematical reasoning that could arise during play. Ryan engaged with the resources but found translating them into instructional practice challenging. Like Emily, he valued the workshop's hands-on element but seemed uncertain about how to plan for deeper learning during gameplay.

These differences reflected broader variations in how the teachers viewed both preparation and the pedagogical role of games. While Ashleigh and Morgan approached planning as an opportunity to explore how and why a game supports mathematical reasoning, others treated games primarily as tools for engagement and fluency. As a result, their planning emphasised ensuring the game ran smoothly rather than designing prompts and discussions that might extend to learning about mathematical ideas.

Reflections on the Pedagogical Potential of Games

The study served as a catalyst for teacher reflection on both the games and their broader instructional practices. All five acknowledged that the experience expanded their repertoire and introduced games with greater mathematical depth than they had previously used. However, the impact of this exposure varied, revealing two distinct trajectories: reaffirming existing approaches versus transforming instructional practice.

Fluency reaffirmed: Emily, Joel, and Ryan

For Emily and Joel, the experience reinforced their existing beliefs. They continued to view games as motivational tools for practising number facts and maintaining engagement, but not central to instruction. Emily said she would use games as a "warm-up" or "rotation activity," while Joel commented, "We do a decent job of using games … We'll probably do it a little bit more, to be quite honest." While these teachers valued games, they continued to treat them as supplementary rather than as tools for developing conceptual understanding.

Pedagogical shift: Ashleigh and Morgan

Although Ashleigh and Morgan already valued games as instructional tools for conceptual understanding, their participation in this study deepened their pedagogical clarity and intentionality. This deepening is perhaps best captured by Morgan's reflection on her experience implementing *Reverse Land Grab*, and her realisation of its pedagogical potential:

> *Oh my gosh, I think they blew me out of the water. I truly did not expect it. I thought it was a game that … I just didn't really think was that interesting. I didn't originally kind of get it, and I was a bit confused, but I think that just shows what a terrific game it is. It had so much to think about, where do you go, why do you go there, what other factors can I use, can we even make that number? … You know, it just had so much. And I've never heard these kids more on-task and enthusiastic and focused the whole time. They were just … yeah. I absolutely think the mathematical thinking was so evident.*

Morgan also recalled: "It was so interesting that the misconception was that that skinny rectangle wasn't an array it's just a line. I thought that was really interesting. I hadn't heard that before." This moment illustrated her insight into how gameplay can surface previously unnoticed misconceptions and provide a meaningful opportunity to address them through discussion and reflection.

Beyond this specific example, Ashleigh and Morgan's more general reflections revealed a shift in four key areas:

- using games to teach mathematical concepts, rather than separating the teaching from the gameplay;
- recognising the parallels between rich games and open-ended tasks;
- approaching game planning with the same rigour as other lessons; and
- emphasising classroom discussion as a key bridge to learning.

Ashleigh reflected on her evolving approach, explaining: "In the past … I wouldn't have been as conscious of using the language, factors, multiplication, products … I would have separated the teaching from the game." Morgan similarly described a change in how she thought about games: "Speaking of prime and composite numbers … It's more been an 'imparting knowledge' thing. Whereas with these games, they were applying it and seeing it happen in real time."

Ashleigh and Morgan also noted that the games they used shared features with open-ended tasks. They gave students space to make choices, explore strategies, and follow different pathways, qualities they hadn't associated with games before. This led them to apply their usual planning approach for open tasks to game-based lessons. Like open-ended or rich mathematical tasks, a well-designed game allows multiple strategies, different solution pathways, and opportunities for comparison and justification (Klooger et al., 2025). In this sense, the focus of the lesson shifted from simply getting an answer or finishing the game to reasoning through choices, why a particular move was made, how it connected to mathematical ideas, and what might be learned from an alternative strategy. Playing for fun alone was not the goal; rather, the emphasis was on how students played and why certain strategies were effective. This mirrors the intent behind open-ended tasks, where learning is deepened through exploring multiple pathways and articulating how an outcome was reached. As both teachers observed, reflective thinking through gameplay, debriefing, discussion, and comparison of strategies was crucial for helping students make sense of the mathematics embedded in the game.

Ashleigh explained, "We all came back together, and I showed one of the kids' game boards … I really thought about misconceptions and anticipated responses more than I would have before." Morgan also described the shift in her planning: "I really understood the maths I wanted the students to learn … I had clear objectives and asked the right questions to promote discussion." Both emphasised the importance of selecting well-designed games and crafting purposeful questions, just as they would with any rich maths task. Morgan even suggested that using games as a main activity was no different from "a regular mathematics lesson." Ashleigh echoed this by noting, "It takes effort to think, this is what I want them to understand, and we're going to approach it by using a game."

Morgan reflected on how her thinking had shifted, "In the past, I've thought, if I'm not explicitly teaching, they're not learning … but I realised I really needed to sit down, understand the game, and ask the right questions. Otherwise, they're just playing for fun." This idea highlights the need for balance between teacher talk and student talk during mathematics lessons. When students play games, they have valuable chances to explain their thinking and share ideas. Teachers, however, still play an important role in helping students use accurate mathematical language and focus on key ideas. The teacher's role is to guide talk, asking questions, and helping students connect mathematical ideas to gameplay. Ashleigh and Morgan both highlighted the importance of teacher-led discussion during gameplay. Reflective dialogue after gameplay thus became a crucial step in connecting strategic decisions to underlying mathematical ideas.

Limited reflection on gameplay: Joel

Although Ashleigh and Morgan described a shift toward more intentional use of games, Joel's reflections suggest that this shift was not shared by all teachers. Joel, in contrast, admitted, "There wasn't a lot of thought behind how I wrapped it up … Usually we'd bring the class together to reflect, but I didn't really do that here." This suggests that, while reflective teaching practices were part of Joel's broader repertoire, they had not yet extended to his use of games, at least in this instance. Playing for fun, in this case, is comparable to completing tasks for the sake of getting an answer rather than focusing on how the answer is obtained. Without structured reflection or discussion, gameplay risks becoming an exercise in speed and success rather than in reasoning and understanding. In such cases, the focus remains on finishing the task or winning the game rather than exploring how and why certain moves or strategies work. The debrief that follows gameplay provides an essential opportunity for students to unpack their reasoning, compare strategies, and connect their choices to mathematical ideas. Without this reflective step, much of the learning potential embedded in the game can remain untapped.

This contrast highlights a central tension in how games are used. While all teachers acknowledged their motivational value, only Ashleigh and Morgan brought the same pedagogical intentionality to games as to any rich maths task. Their reflections show that meaningful learning through games is possible, but only when paired with thoughtful planning, clear goals, and purposeful facilitation. It is perhaps ironic that the two teachers who already held the most sophisticated views about games appeared to experience the greatest shift in their practice as a consequence of participating in the study.

Discussion

Answering the Research Questions

This section draws together the findings to address the study's two research questions:

RQ1: How do teachers' beliefs and motivations shape their use of mathematical games in the classroom?

This study supports earlier findings (e.g., Russo et al., 2021) that games are widely valued for their motivational appeal. All five teachers reported high levels of student engagement during gameplay, affirming that enjoyment is a key reason for using games in mathematics instruction. The findings, however, also revealed that motivation alone, whether among students or teachers, is not a reliable predictor of meaningful learning outcomes. While students may be highly engaged and enjoy the game, this does not necessarily mean they are developing strong mathematical reasoning or understanding. Similarly, a teacher may be enthusiastic about using games, but without careful planning or a clear connection to key concepts, learning may remain superficial. In this study, deeper learning occurred not simply because students were motivated to play, but because of how games were selected and implemented. The findings revealed that teachers' pedagogical beliefs, particularly regarding the instructional purpose of games, shaped both how and why games were used. Ashleigh and Morgan viewed games as tools for reasoning and conceptual understanding, aligning with the vision articulated by Ernest (1986), Clarke and Roche (2010), and Russo et al. (2023), who advocated for games that support all four mathematical proficiencies. These teachers integrated games into core instruction, selected them based on conceptual fit, and crafted questions to provoke reasoning and discussion. Their participation in the study deepened and refined this orientation, reinforcing their view that games can offer more than surface-level engagement.

By contrast, Joel and Emily positioned games primarily as tools for fluency and engagement, using them to make practising multiplication tables more enjoyable. Their use of games focused on recall and repetition rather than on extending mathematical ideas. This pattern reflects prior research (e.g., Afari et al., 2013; Kacmaz & Dubé, 2022; Swan & Marshall, 2009), which found that many teachers use games to reinforce number facts rather than as a deliberate pedagogical choice that could support understanding of mathematical ideas.

Importantly, the study also highlighted that teachers' beliefs about how new mathematical ideas should be introduced significantly influence how games are positioned in instruction. A common assumption in mathematics teaching is that conceptual understanding must first be explicitly explained by the teacher before students engage in games or other activities. Within this view, games function primarily as opportunities to practise or reinforce ideas that have already been taught. Ashleigh and Morgan challenged this traditional sequence. Rather than seeing gameplay as something that follows instruction, they described games as contexts through which new mathematical ideas could emerge. In their classrooms, students were encouraged to explore patterns, test strategies, and discuss their thinking while playing, allowing conceptual understanding to develop through the activity itself. From this perspective, games were not merely a consolidation task but a legitimate entry point for introducing and investigating new concepts.

This evolving view was closely tied to a broader professional mindset. These teachers approached the project as an opportunity to extend their practice, engaging deeply with the materials and reflecting on how games could support conceptual growth. By contrast, Joel and Emily, while confident with their existing routines, showed less inclination to rethink their instructional use of games. Although they were motivated to use games and claimed that they use them frequently, there was little evidence of motivation to evolve their own practice. Ryan's case offers a cautionary note. While he valued games for fluency and engaged with the materials provided, he struggled to translate them into instruction that supported deeper learning. His experience suggests that access to well-designed games and resources is insufficient; some teachers may require additional professional development or pedagogical support to enact them effectively.

Ultimately, the purposeful connection between belief, planning, and practice determines whether games are used for conceptual insight or remain enjoyable but superficial tasks. Ashleigh and Morgan demonstrated these connections by using games to engage students, provoke reasoning, encourage dialogue, and build connections among representations and underlying mathematical ideas. Their planning was deliberate, grounded in clear learning goals, and supported by timely teacher prompts and structured reflection. In contrast, Joel and Emily used the same games with minimal adaptation or support. Their lessons emphasised game flow and enjoyment but offered limited opportunities for mathematical exploration or discussion. This contrast illustrates that the educational power of games lies not in their design alone, but in how teachers use and implement them.

RQ2: How do teachers' implementation of game-based lessons reflect or differ from the pedagogical potential of games as teaching environments?

Game implementation varied markedly across classrooms. Ashleigh and Morgan embedded games into their lessons to promote inquiry, discourse, and conceptual insight, realising the pedagogical possibilities described by Ernest (1986), Swan and Marshall (2009), and Russo et al. (2023). Their game use was marked by intentional planning, integration with learning goals, and facilitation that supported student reasoning.

In contrast, Joel and Emily used the same games but primarily as structured fluency tasks, with limited attention to conceptual development. Their lessons focused on engagement and repetition, with minimal teacher guidance to support deeper learning or discussion. This aligns with concerns raised by Heshmati et al. (2018), who cautioned that even well-designed games can be reduced to surface-level or routine gameplay, in which students are engaged in "just playing" rather than thinking mathematically, unless supported by deliberate teacher guidance. This study builds on that insight by emphasising that purposeful explanation of instructional material is equally critical. How teachers interpret a game's purpose, understand its mathematical potential, and embed it within a broader pedagogical direction, with deeper reflective understanding, determines whether its conceptual value is realised.

Conclusion

This study demonstrates that the instructional value of non-digital mathematical games is not an inherent property of the games themselves but is fundamentally shaped by the teacher's pedagogical intent and beliefs. While all participants in this study successfully leveraged games to foster high levels of student engagement, the research reveals a significant divergence in how that engagement is translated into learning. The findings suggest a clear distinction between two instructional trajectories: one in which games serve as supplementary tools for fluency and "fun," and another in which they are positioned as central, inquiry-based environments for developing conceptual understanding and reasoning.

A key contribution of the study is the distinction it reveals between using games as enjoyable vehicles for practice and using games as environments for mathematical inquiry. In some classrooms, games remained peripheral to the main work of the lesson, functioning primarily as warm-ups, consolidation tasks, or motivating alternatives to drill. In others, games were positioned as the lesson itself: as settings in which important mathematical ideas could be introduced, explored, and discussed.

More broadly, the study raises important questions about how teachers are supported to use games in ambitious ways. To fully realise the potential of games as spaces where students explore mathematical ideas through play, professional learning must focus not only on providing access to well-designed games, but also on strengthening teachers' pedagogical practice. Teachers need support to recognise the mathematical affordances within a game, anticipate the thinking it might provoke, and plan questions and discussions that connect play to broader mathematical ideas. In this sense, professional knowledge about how to teach through games may be just as important as knowledge of which games to choose.

Nearly four decades ago, Ernest (1986) imagined a classroom where games were meaningfully embedded into mathematics instruction. This study calls for a renewed commitment to Ernest's vision, in which games are not simply a way to make practising mathematics more enjoyable but are purposefully used and embedded in instruction as central tools for helping students make sense of mathematical ideas.

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Ethical approval

Ethical approval for the research was granted by Monash University, and informed consent was given by all participants for their data to be published.

Competing interests

The author declares there are no competing interests

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Appendix 1. Games Used in the Study

Game 1: Skip Counting Bingo (Russo & Russo, 2018)

Materials: 120-chart, dice (6-, 10-, 12-, or 20-sided), five counters per player.
Goal: Remove all counters by landing on chosen numbers during skip-counting sequences.
How to Play: Players select five numbers above 20. A die is rolled, and all players count by that number using the 120-chart. When a chosen number is called, its counter is removed. First to remove all wins.
Mathematical Focus: Explore how numbers belong to multiple skip-counting sequences (factors). Understand relationships among factors, multiples, and primes. Builds fluency in skip counting, problem solving (choosing high-factor numbers), and reasoning about likelihoods.

Game 2: Doubles Bingo (Russo, 2016)

Materials: 120-chart, dice, five counters per player.
Goal: Remove all counters by landing on selected numbers through doubling sequences.
How to Play: Players choose five numbers above 20. After rolling the die, everyone doubles sequentially from that number. When a player's number is called, they remove a counter.
Mathematical Focus: Strengthen understanding of doubling as repeated addition and as a special case of multiplication by 2. Supports fluency in doubling, place value, and even/odd reasoning.

Game 3: Choc-Chip Cookies (Russo et al., 2022)

Materials: Cookie gameboard, dice.
Goal: Maximise total choc-chips on the board after five rounds.
How to Play: Roll a die to determine how many choc-chips per cookie. Players arrange and record totals for each row across rounds.
Mathematical Focus: Model multiplication through arrays, explore the commutative property (e.g., 4×5 vs. 5×4), and apply reasoning to maximise totals. Encourages planning, efficient calculation, and use of distributive strategies.

Game 4: Reverse Land Grab (Russo & Russo, 2021)

Materials: Grid paper, dice (20-sided or two 10-sided).
Goal: Claim the largest total area on the grid.
How to Play: Roll to generate a product and draw a rectangle showing one possible factor pair (e.g., $12 = 3\times4$). Shade the area and label with the fact.
Mathematical Focus: Distinguish between prime and composite numbers by exploring factor pairs. Reinforces fluency with multiplication and conceptual understanding of area and factors.

Game 5: Three-in-a-Row Lucky Numbers (Russo, 2018)

Materials: 120-chart, two dice.
Goal: Be first to complete three "three-in-a-row" lines.
How to Play: Roll two dice to create a multiplication fact, mark the product on the chart, or choose another number if it's already taken ("lucky" rule).
Mathematical Focus: Explore factors, multiples, and prime numbers. Supports reasoning about which products are more or less likely and strengthens fluency with multiplication facts.

Appendix 2. Interview Protocol

Preliminary teacher interview

How do you use games to support your mathematics instruction?

How do you use games to support the 4 proficiencies i.e., understanding, fluency, problem solving and reasoning?

Why do you use games?

How often do you use games in your mathematics lessons?

How do you select the games you choose to play? What factors influence your selection of games?

What is your role when children are playing games?

What are the benefits of using games?

What are the drawbacks of using games?

Which games did you choose?

Why did you select these games?

Why did you choose to play the competitive version of this game and the collaborative version of the other game?

What are you anticipating the students might learn from playing each game?

Debrief following each lesson: How will you know the game was successful?

How do you think the lesson went?

Did the lesson go as you intended or did you deviate from what you planned? How and why?

Did you achieve your pedagogical outcomes?

To what extent were students engaged in mathematical thinking?

To what extent were students engaged in playing the game?

To what extent did you feel that students enjoyed playing the game?

In your opinion, was the discussion by students while they were playing focussed on the mathematics or were children more focussed on the rules and winning?

What did you do while the students were playing?

How will you build on the learning today?

Post-game-based lessons interview

You played these two games what was the same what was different about these games?

Which game do you think was more effective? why? Prompt: competitive vs collaborative, the game objects, and the level of mathematical challenge offered.

How do you intend to use games in the future?

To what extent has this been influenced by the experiences you have had in this project?

Having taught those two-lesson last week and having a bit of space to reflect on those lessons is there anything else you would like to tell us about teaching with games in general?

What sort of PL do you think would be useful to you when we reflect on teaching with games?

What was it that influenced how you taught with the games and implemented them in the classroom? Was it the analysis of the game, playing the game during the exposure to games workshop, the professional reading or something else. Please explain?