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STRIKING GOLD: INTRODUCING DRAMA-MATHS*

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Abstract

Conducted within a Masters in Teaching and Learning, this article details an inquiry which sought to offer meaningful purpose to learning within a fictional frame to engage students in level two mathematics. After considering various ideas for a suitable theme we settled on a pirate adventure. Enticing students with a mysterious treasure map and creating various obstacles and amusing characters along the way. As a frame for mathematics, pirates provided an additional opportunity to invite incidental thinking about mapping, position and measurement.

As a preservice primary school teacher and research advisor, we have written collaboratively to reflect the shared research experience. While adopting different roles within the research, we share a passion for exploring new pedagogies, valuing student voice and collegiality. This short overview identifies our initial positions within this research.

Pirate Kelly

The focus of this research arose from a desire to better my own practice after struggling to engage children with mathematics in my first practicum. Whilst I have always really enjoyed mathematics, it is commonly regarded negatively and labelled difficult and mundane (Ahmed, Minnaert, Kuyper & Van der Werf, 2012; Kele & Sharma, 2014,). After a valuable experience incorporating narrative into a maths lesson and encountering drama as pedagogy at University, I began to wonder how process drama might provide a relevant, meaningful, active and embodied context for mathematics (Calderazzo, 2015, Carter & Westaway, 2005).

Pirate Claire

New to the role of research advisor, I was keen to support Kelly and her enthusiasm for incorporating drama into mathematics. This offered an opportunity to work collaboratively in an area of passion and honour my commitment to classroom teaching. Kelly and I met frequently to reflect upon each session, plan next steps and discuss evolving understandings. Visiting the classroom before and during the inquiry deepened my relationship with the students and enabled richer discussions. This collaboration has been invaluable to my own development as an emerging scholar and reflective practitioner.

Choosing our destination – Why drama and maths?

Over the last few decades concerns about poor engagement and scores in mathematics have arisen (Fielding-Wells & Makar, 2008, OECD, 2014). Research indicating a direct correlation between mathematics pedagogies and decreasing popularity and outcomes have increased interest in exploring alternative pedagogies (Moore, 2012, Calder & Murphy, 2017).

Frequently taught didactically, mathematics tends to position teachers and textbooks as an unquestionable authority. Traditionally positioned as an individual, competitive subject, requiring memorisation and the rote learning of formulas and facts, mathematics is associated with singular answers and objective methodology (Moore, 2012). This absence of collaborative learning coupled

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Pages 9-18

with often intangible and abstract concepts can make mathematics hard to engage with and contribute to its unpopularity (Carter & Westaway, 2005; Ufuktepe & Ozel, 2002).

**Name gifted to this process of using drama to teach mathematics by the students involved*

Conversely process drama demands collaboration, engaging students through an embodied imagined narrative which provides real problems to solve and invites active questioning within a playful fictional space. This research, therefore, investigated the potential of enacting mathematics through drama asking;

How can we use process drama techniques to engage children in mathematics learning?

While not obvious bedfellows, substantial research exists regarding the benefits of teaching mathematics using drama, highlighting its ability to reduce anxiety, increase social interaction and develop persistence (Armstrong, 2000). Drama can improve problem-solving, reasoning, communicating and relating while fostering creative and critical thinking skills (Jefferson & Anderson, 2017). Mathematics and drama both offer different mechanisms for making sense of the world and navigating a path through it.

Mapping the terrain

Process drama is an improvised, experiential form that employs drama as a medium for learning. Through the conventions, techniques and elements of drama, participants create and sustain a fictional context in which to explore an issue of interest (Heathcote & Bolton, 1994). Students are valued as co-contributors to the drama and invited as participants to negotiate and construct knowledge. The teacher works inside the drama to assist while managing the dramatic tension to capture and sustain the commitment to the given project or inquiry. Wrapping the narrative fiction around a curriculum area adds significant interest by giving it relevance and palpable meaning.

Mathematics in New Zealand involves the “exploration and use [and communication] of patterns and relationships in quantities, space, and time” (Ministry of Education (MoE), 2007 p.26). Regarded as a high-status compulsory subject, the now defunct National Standards in numeracy ensured its dominance in New Zealand schools, raised the stakes and narrowed teaching approaches (Thrupp, 2013). Consequently, excellent test results became a key priority for schools and a source of anxiety for students (Bonne, 2016, Gerritson, 2017). This study focused on teaching multiplicative thinking to a small group through a drama based approach to inform teacher practice and employed qualitative methodological approaches.

Gathering supplies - Planning for drama

Underpinned by a constructivist paradigm conscious of the ‘messiness’ of classroom research, teaching as inquiry (TAI) provided the dominant research method. TAI offers an approach in which educators themselves investigate the impact of their practice upon students as part of an ongoing lifelong learning process (Education Review Office, 2012, p.1). This ongoing cycle of inquiry is structured upon three foundational questions:

- The focusing inquiry - what is important for my students, to meet them where they are at?
- The teaching inquiry - what strategies, based on evidence, are the most beneficial for my students’ learning?
- The learning inquiry - what happened in that learning and what does this mean for my future teaching (Aitken & Sinnema, 2008; Amos, 2010, Benade, 2015; Ministry of Education, 2007)?

This research was conducted on practicum at a mid-decile full primary school. Research participants were gathered from an existing middle ability mathematics group of 10 ethnically diverse, Year 3 and 4 or 7 and 8-year-old students. Data was collected through participant observation, critical friend discussion and semi-structured focus group interviews. Although the lessons occurred within

dedicated mathematics time, the group worked in an allocated partitioned space. Pseudonyms were assigned to all participants in accordance with the ethics agreement.

Some initial barriers were encountered as we planned to launch the drama inquiry. The school, while supporting the practicum inquiry, reinforced the primacy of the mathematics in any drama intervention. Similarly, another compulsory mathematics programme limited session times to twice a week over the three week period. Subsequently, concessions were made to the process drama to meet these school requirements. As a result, greater teacher authority was required within the drama to ensure momentum and numerous compromises made to accommodate the requirements of the mathematics curriculum. We regularly negotiated this tension between the integrity of the evolving drama and required mathematics. As the class had little prior drama experience, we facilitated a drama session prior to the inquiry and efforts were made to cultivate a relationship of trust between the teacher, advisor, student and children. We employed a variety of drama conventions during the inquiry based upon Neelands and Goode (2000) which are detailed below.

Drama conventions

- Role on the wall - a significant role is drawn ‘on the wall’ and information is written collectively onto the character as a form of building the understanding of the role.
- Freeze frame - groups work together to use their bodies to represent a moment in time, an idea or a theme and freeze in their desired position.
- Teacher in role - the teacher or facilitator takes on the role of a character used in the drama to create tension, pique interest, invite deeper thinking and alter power relationships by taking on roles different to that of the teacher.
- Blanket role - when all participants take on the same role, for example in this inquiry all participants including the teacher were treasure pirates, and all must agree to the fiction.
- Soundscape - the group are encouraged to reflect on a character or setting and select the sounds that are most representative, working together to create the ‘feeling’ of the character or setting.
- Thought tapping - requiring reflection and analysis of the roles and situation they are in, the participants publicly reveal private thoughts and feelings in the role at a given moment in time and can be used when characters are frozen or presenting a still image.
- Mapping - creating maps of a certain setting in the drama to tap into experiences leading into the drama, to reflect on what has happened after the drama or used as a stimulus during the drama.
- Flashback - moments in the past are created to build and reinforce the present moment in the drama.

The following overview summarises the drama-maths experience and details the initial pre-text which invited the students into the drama.

Baiting the hook – Pretext for drama

Joanna (Kelly in the role) comes to the class for help, she recently found a bottle while out beachcombing and is hoping the group can think of ways to make it into a nice gift for her mother. Students quickly recognise a potential map contained inside and agree to work together as ‘treasure pirates’ to seek the treasure.

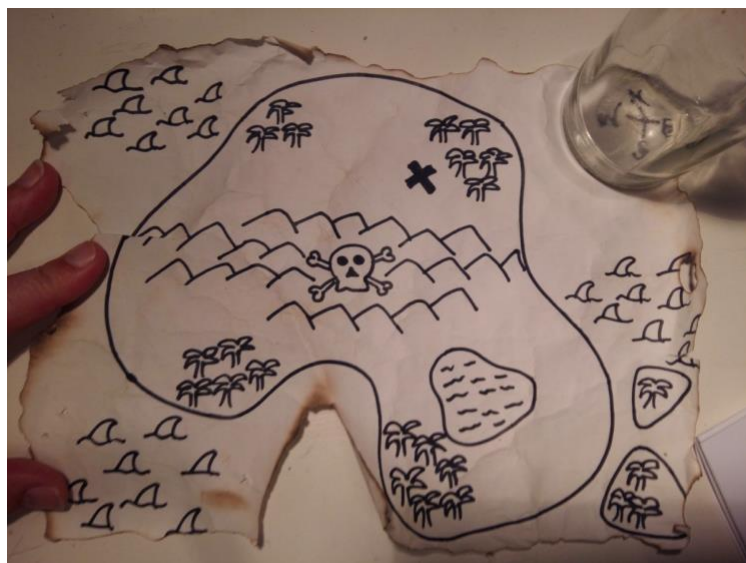


Figure 1: Map in a bottle

The following table summarises the design and implementation of the drama. After each lesson, we met to discuss, reflect and plan the session. This ensured that the drama remained responsive and fulfilled the mathematics requirements.

Lesson	Lesson Activities	Drama Techniques	Mathematics Learning
Lesson 1	<p><u>Building belief</u></p> <p>Opens with a teacher in the role as Joanna. Students invited into the fiction.</p> <p>Group agrees to help Joanna and group work in the fiction. Create a role on the wall for a treasure pirate.</p>	<p>Teacher in role</p> <p>Blanket role</p> <p>Role on the wall</p>	<p>None, as the focus of the lesson was building belief, establishing context and hooking the interest of participants.</p>
Lesson 2	<p><u>Planning the voyage</u></p> <p>Flashback freeze frame - past trips and treasure hunting trips.</p> <p>Decided upon the length of the trip and supplies needed.</p> <p>Working out numbers of some supplies for the trip.</p>	<p>Freeze frame</p> <p>Flashback</p> <p>Thought tapping</p> <p>Blanket role</p>	<p>Multiplication of a number of pieces of bread for each person for the trip for each day, then for the trip duration and then total for the whole crew.</p>

<p>Lesson 3</p>	<p><u>Starting the journey and making land</u> Packing the ship Fast forward to arrival. Building drama using flashback, freeze frame and thought tapping to re-live the treacherous trip. All food lost in storm, need to gather coconuts for food. Calculating how many we need to survive.</p>	<p>Freeze frame Flashback Thought tapping Blanket role</p>	<p>Multiplication - working out how many coconuts we could each carry and so how many coconuts we need as a group. And we needed 55 coconuts (5 each for 11 of us) and 3 coconuts in each tress - how many trees do we need to climb to get the coconuts?</p>
<p>Lesson 4</p>	<p><u>Journey through Deadman's Cave</u> Soundscape build belief in the island. Agree to go through Deadman's Cave Meet Barnaby*, the keeper of the cave. Code/warnings given to enter the cave. Meet the 'Bingles' creatures that multiply with noise. Solve the puzzle to defeat them with a song. Eat the Bingle's legs.</p>	<p>Soundscape Teacher in role (Research Advisor as Barnaby) Blanket role</p>	<p>Multiplication - working out riddles of different multiplication problems to crack the code to get into the cave.</p> <p>Doubling numbers - 2 become 4, 4 become 8 etc as bingles split and multiplied</p> <p>Multiplication and division - how many legs are there to eat? How many each?</p>
<p>Lesson 5</p>	<p><u>Finding the treasure</u> Soundscape to recap on the journey through the cave. Bird delivered riddle and coded key with directions for the treasure chest. Digging up the treasure and opening the chest. Reflect on treasure pirates' thoughts.</p>	<p>Soundscape Blanket role Thought tapping Slow motion</p>	<p>Fractions and multiplication used as directions - half turn, quarter turn, and multiplication riddles for a number of steps. Multiplication - solving multiplication problems in varying representations to crack the key code.</p>
<p>Lesson 6</p>	<p><u>Fast forward in time</u> Recover at pirate headquarters from the trip. Use mapping to draw the treasure pirate headquarters. Flashback to dividing treasure. Give Barnaby and Joanna some treasure. Discuss how they spent the loot. Thank you letter from Joanna Thank you, text, from Barnaby.</p>	<p>Mapping Flashback Blanket role</p>	<p>Division - how many pieces of treasure do we each get if we divide it equally between us? What about if we give an equal share to Barnaby, then how much we will each have?</p>

they LOVED it! This really drew them all into the fiction, spontaneous discussions about pirates and treasure hunters. All engaged and focused. (Field Notes - Monday 4th September 2017)

As noted by the classroom teacher students were completely absorbed by the pirate tale and enjoyed using their imaginations. This 'pretend' element invited playfulness and creativity. Acting within the imagined space liberates students from their ideological realities and as Dewey suggests allows them to find new approaches to learning and viewing the world (Simpson, 2006). Participants were happy to engage in purposeful play within the imagined world. As noted by the classroom teacher there was a collaborative use of equations within the 'drama-maths' and discussions between participants were consistently on-task and collegial. Reporting back to Kelly she commented:

If all maths lessons could be like this, children would never want to do anything else. I don't think they were really aware that this was a maths lesson. You mentioned the amount of preparation involved and, of course, as you develop this way of teaching you will fine tune the practicalities. Most noticeable throughout the lesson was the high level of engagement amongst the group - all talk was on-task and the relationship between you and the children was very natural and trusting.

(K. Wade, personal communication, September 19, 2017)

Difficulty

Of central concern when planning the drama-maths sessions was determining the optimal level of difficulty for the mathematics activities. Calculating supplies for the voyage or dividing the loot, offered a salient purpose for the mathematics and motivated the pirates to actively participate in problem solving. However, a tension remained between meeting the needs of the unfolding narrative, the mathematical capabilities of the group, and the school requirements. Research suggests that students faced with mathematics they deem too easy, consider it worthless (Sparrow, 2008). Keen to challenge the students with significant mathematical problems and ensure an appropriate level of dramatic tension we conceded to an increased teacher presence at times. We discovered, however, that when motivated students would continue to grapple with a problem even when it well exceeded their probable ability. Potentially they overcame the daunting mathematics because they were motivated to find a solution and take greater agency as the creators and actors within the drama world.

As Kelly recalls;

The coconut maths problem was really tricky for them but with prompting and materials, they all were engaged in trying to work this out for an extended time. We agreed that we could carry five coconuts each in our bags so with 11 of us we would need 55 coconuts, there were three coconuts up each tree so how many trees would we need to climb to get enough coconuts? At first, they struggled with the concept that it wasn't a nice even fit and were trying to find the number that made it work but as they worked with their materials, I could see them really challenged to work out how many trees and realising it wasn't a nice neat fit but messy and like real life.

(Field Notes - Tuesday 12th September 2017).

A student also expressed a sense of enjoyment from the challenges presented to her;

Sasha: I like that we had laughter and fun but then had to get on with the work

(Focus group interview, September, 2017)

Agency

The collaborative nature of process drama ensures that student participation is required. Drama cannot exist without a tacit agreement amongst all participants to the fiction (Neelands, 2009). As an experiential and exploratory approach, process drama recognises and utilises students own lived experiences (Heathcote & Bolton, 1994). Sharing the responsibility for the creation of the fictional world, narrative, decisions and actions allowed students to take control of the drama and themselves.

They elected to go treasure hunting, opted to take on specific roles within the drama, offered advice and chose to equally divide the treasure amongst them. When asked what they enjoyed they communicated this sense of agency saying;

Sascha: I like we had to choose our name and we put our ideas together

Natalie: I like that we don't have to put our hands up

(Focus group interview, September, 2017)

Additionally, our position as participants within the drama relieved us from the roles of 'all-knowing teachers' and emboldened students' voice. This shift in the power dynamics between students and teachers can raise the level of agency students traditionally experience within the classroom (Carter & Westaway, 2005; Coleman, 2010).

What's on the horizon?

In this study, the imagined world provided a context for engaging with mathematics concepts meaningful to the everyday life of the treasure pirates. Students were required to construct meaning from their own experiences and invited to apply mathematical concepts in an organic way. Relying upon the familiar skills of children's play lessened anxiety, encouraged fun and suggests the value of incorporating the imagination into a mathematics pedagogy. Students' voiced this sense of fun stating:

Natalie: The thing that is fun is using our imaginations to make maths more fun

Sascha: We used our maths equations from our book and we use our imaginations to make it more interesting

(Focus group interview, September, 2017)

Creating a safe environment in which to experiment may lessen anxieties, encourage risk taking and build self-confidence. An increase in positive associations with mathematics through interactive experiences such as drama may counter the negative discourses which currently surround it (Armstrong, 2000, Kele & Sharma, 2014). Drama as a negotiated fictional space allows for safe risk-taking, pirates who fail to pack enough coconuts will not actually starve and numerous attempts can be made to solve problems without fear of 'real' consequence (Fraser et al., 2012).

Success in mathematics currently depends on a narrow set of skills, demonstrated individually. Teaching mathematics through drama engages mathematical thinking through social, emotional and physical thinking. This extends the potential for success to a wider cohort as a broader range of contributions are sought. Sharing responsibility for the task ensures a sense of shared satisfaction and competency in its completion. Students who gain greater confidence will take more agency and responsibility for their learning.

Trouble at sea

As part of a MTeach, this inquiry was significantly limited in terms of time, sample size and expertise of the researcher. The research group was conveniently sampled from the practicum class and operated in a conservative teacher-led model. The study was small in scale and the research was conducted by a preservice teacher unfamiliar with process drama. Regardless, this study's findings can contribute to the literature on drama integration and the ongoing reflective practice of both the teacher and advisor.

Recruiting more pirates

Taught predominantly by a non-drama specialist novice teacher, this study challenges the fear that only expert drama practitioners should teach drama and offers an invitation to emergent practitioners (Sayers, 2012). This research affirms a need to adopt pedagogies for mathematics that encourage 'relevant and active participation to increase the positive experiences, student confidence and engagement' (Fielding-Wells & Makar, 2008, Kele & Sharma, 2014). Employing drama in mathematics in this study provided a space for meaningful learning and increased student agency and

engagement (Armstrong, 2000). Further research could explore incorporating the significant elements identified here; utilising imagination, varied mathematical challenges and valuing the student voice through other mechanisms.

Incorporating drama into other curriculum areas is not new. Significant research already exists advocating for the deployment of drama techniques within generalist classrooms to capture, motivate and engage students (Heathcote, Johnson & O'Neill, 1990, Edmiston, 2013). Despite significant academic study and praxis, teachers remain afraid to employ drama for fear of getting it wrong (Sayers, 2012). This inquiry does not offer an exemplary process drama model and was fraught with compromises and missteps, yet they offer valuable insights for future research and practice. This small nugget offers sustenance to teachers who perceive drama integration too complicated for the rigours of the daily classroom. Perhaps as indicated here, drama can offer tangible benefits without expert interventions or overwhelming workloads. Far from an example of flawless drama expertise, this study offers hope to beleaguered classroom teachers eager to try something new.

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