Enjoyable Mathematics Lessons can be Contagious

Maggie Feng
University of Sydney
mfen5873@uni.sydney.edu.au

Janette Bobis
University of Sydney
janette.bobis@sydney.edu.au

Bronwyn Reid O'Connor
University of Sydney
bronwyn.reidoconnor@sydney.edu.au

Jennifer Way
University of Sydney
jennifer.way@sydney.edu.au

The current study explored the reasons for students' preferences for the teach-first and task-first lesson structures, and whether students' preferences were influenced by their perceptions of the teacher's preference. Students (n=18) from two composite Year 3 and 4 classes (aged 8-10 years) completed a post-lesson drawing task and participated in a semi-structured interview following a series of lessons. Findings indicated students had a variety of reasons for their preference of lesson structure. Most focus students reported noticing aspects of the teacher's enjoyment during instruction. The results have implications for the way teachers inadvertently influence their students' own enjoyment of and preferences for instructional approaches.

Numerous interactions occur between teachers and students each day. Such interchanges can range from individual discourses to those between a teacher and all students within a classroom. During these exchanges, teachers and students inevitably affect each other. For instance, if teachers are experiencing enjoyment while teaching, they may project their enthusiasm by speaking faster, and exaggerating their gestures and expressions (Frenzel et al., 2017). Students commonly notice their teacher's excitement and approach lessons with the same level of excitement and engagement (Keller et al., 2016). This type of influence on student engagement is of significance not only across various subjects or topics within a subject, but also regarding the implementation of a specific pedagogical approach including the way in which lessons are structured. The study reported in this paper is part of a larger project designed to investigate Year 3 and 4 students' engagement with teach-first and task-first lesson structures that incorporate challenging mathematical problem-solving tasks. The aims of the current study were to investigate the reasons for students' mathematics lesson structure preferences and explore whether their perceptions of the teacher's preference influenced their own preferences.

Literature Review

Teach-first and Task-first Lesson Structures

Mathematics lessons can be structured in various ways. For example, a lesson can be structured to begin with teacher directed explanation and discussion, followed by students independently solving tasks (teach-first). A lesson can also begin with independent student exploration followed by discovering key mathematical ideas as the lesson unfolds (task-first). There are those who advocate the effectiveness of the task-first lesson structure (Sullivan et al., 2020), but also those who argue that different benefits can be derived from both teach-first and task-first structures (Russo & Hopkins, 2019). See Table 1 for the components of the task-first and teach-first lesson structure. Indeed, the way lessons are structured to integrate the various instructional strategies is an important consideration for optimising mathematics learning. This is because student engagement is directly impacted by how tasks are located within the structure of a lesson as well as the teacher's implementation (Sullivan et al., 2016). However, studies that explicitly explore primary aged students' preferences for different lesson structures that include challenging mathematical tasks are rare. Because students are directly impacted by the extent to which they are engaged in a lesson, it is important to explore their perspectives of what they find enjoyable and engaging.

Table 1

Components of the Task-first and Teach-first Lesson Structure

Task-first lesson structure	Teach-first lesson structure
Introduction: Tuning-in activity.	*Introduction*: Tuning-in activity.
Launch challenging-task (without telling).	Model and explain possible strategies for solving challenging task.
Body: Students explore challenging task independently and are spotlighted as the lesson unfolds.	*Body*: Students explore similar challenging task independently while teacher monitors and helps.
Conclusion: Whole class summary.	*Conclusion*: Whole class summary.

Student Perceptions of Teacher Enthusiasm and Transmission of Enjoyment

It has been suggested that enthusiastic teaching behaviours are displayed verbally and nonverbally when teachers feel enjoyment (Frenzel et al., 2017). When higher levels of enjoyment are felt during teaching, it is more likely for such emotions to be observable by students via enthusiastic teaching behaviours. Furthermore, students who perceive their teacher display higher levels of enthusiasm tend to enjoy learning more (Frenzel et al., 2009). When students experience positive emotions such as enjoyment in the classroom, they become more intrinsically motivated and interested to engage in learning and academic content (Renninger & Hidi, 2016). The control-value theory of achievement emotions (Pekrun, 2000) implies that people's emotions are influenced by their perceptions of the behaviours noticed from their interaction partner. Frenzel et al. (2017) interpreted the mechanisms responsible for the reciprocal relationship between the teachers' and students' emotions by using Pekrun's (2000) control-value theory of achievement emotions. The implications of gaining a deeper understanding of how enjoyment is transmitted between teachers and students in the classroom includes providing valuable insight into how teachers can best manage and shape social interactions to maximise student engagement in the classroom.

Although the idea of enjoyment transmission between teachers and their students makes intuitive sense, the phenomenon of enjoyment transmission in the classroom remains underexamined. In a study involving 149 Grade 9 students across four different subject domains in Switzerland, Becker et al. (2014) found that student perceptions of their teachers' emotions and instructional behaviours significantly shaped their own emotions in class. Similar findings were established in a study by Bakker (2005) with 178 music teachers and 605 students from 16 different music schools in the Netherlands. His findings demonstrated an emotional contagion between students and teachers who reported experiencing flow (absorption, work enjoyment, and intrinsic work motivation) (Csikszentmihalyi, 1997). Furthermore, a positive correlation between teachers' and their students' enjoyment was found by Frenzel et al. (2009) using self-reported enjoyment data of 1542 Grades 7 and 8 students from 71 mathematics classrooms in Germany. Despite these studies providing insight into the positive relationship between a teacher's and their students' enjoyment, the questionnaires with Likert scale items designed for students to self-report (e.g., "This teacher teaches with enthusiasm") does not give qualitative information about the students' reasons for their perceptions. Moreover, studies have mostly been conducted in European countries, with secondary aged students, and across various subjects. Therefore, little is known about emotional transmission with primary aged students in the Australian context, and even less so during lessons in which the content and tasks are identical but presented using different instructional approaches.

The study reported in this paper was guided by Pekrun's (2000) control-value theory of achievement emotions and designed to answer the following research questions:

- Do students prefer one lesson structure over another? If so, why?
- Are students' preferences for a task-first or teach-first lesson structure influenced by their perception of their teacher's preferences? If so, what aspects of the teachers' behaviours do they perceive?

Methodology

The intervention study adopted a qualitative, exploratory design with multiple data sources including a post-lesson drawing task and semi-structured interviews. Two classes of students were initially randomly allocated to one of two intervention conditions–the task-first lesson structure and the teach-first lesson structure. After the initial allocation of each of the two classes for the first half of the unit of work (3 lessons), the task-first and teach-first lesson structures were inverted such that each class participated in the other condition for the second half of the unit of work involving the same mathematics content (3 lessons). There was a total of 12 mathematics lessons (6 lessons x 2 topics) spread across 4 weeks of instruction. All lessons for both classes were taught by the same teacher who has considerable expertise with teaching with challenging mathematical tasks across both lesson structures due to prior involvement in another research project.

Participants and Data Collection

A purposive sampling method (Polkinghorne, 2005) was used to select participants for this study. Two multi-aged classes of Year 3 and 4 students (aged 8-10 years) (class A, $n = 21$; class B, $n = 19$; $N = 40$) from a Catholic primary school in Victoria participated in this investigation. The school was invited based on the criteria: current or recent student experience with challenging tasks in the classroom; willingness of principal, teachers, students, and their parents to participate. A group of nine focus students per class ($N = 18$) was invited to participate in individual semi-structured interviews with the researcher to allow for the in-depth exploration of students' perceptions of each lesson structure. Potential focus students with various mathematics engagement and performance levels were identified from their responses to a teacher constructed content pre-test and a Motivation and Engagement Survey (Martin et al., 2015) completed prior to the intervention.

Administered at the end of the first lesson of the final week (Lesson 9 out of 12), the post-lesson drawing task consisted of a blank sheet of paper on which all students drew either a happy, neutral, or sad face to represent the extent to which they enjoyed the lesson (see Figure 1). Students were encouraged to provide a reason for their response. Shortly after the lesson, the focus students participated in an individual interview with the researcher in which they were asked questions about their preferences for each type of lesson structure, including the questions: "Which lesson structure do you think is better for your learning (and why)?" and "Which lesson structure do you think Ms J (the teacher) prefers teaching (and why)?".
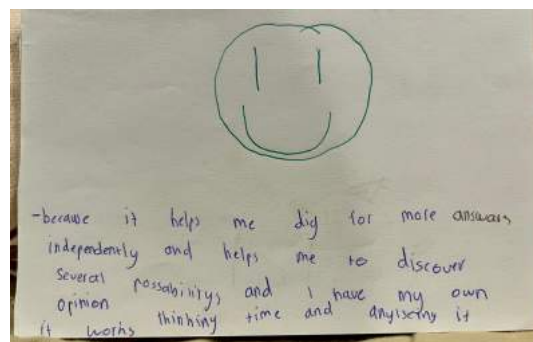

Figure 1. Post-lesson drawing task demonstrating enjoyment in the task-first lesson.

Data Analysis

Individual interviews with the focus students were transcribed. Student responses were first coded as indicating a preference for: (1) the task-first lesson structure; (2) the teach-first lesson structure; (3) equally preferred; or (4) unsure of their preference. The total number of students that preferred each lesson structure and their perception of the teacher's preference for a particular lesson structure were calculated. Next, an inductive thematic analysis (Braun & Clarke, 2006) was used to identify patterns of meanings for students' reasoning towards their preference for the lesson structure. All data were collated on an Excel spreadsheet.

Results and Discussion

Due to length limitations, only data from the focus students will be reported in this paper. The results are reported in three parts. The first part examines the number of focus students that perceived either the task-first or teach-first lesson structure to be better for their learning and their corresponding reasons for such preferences. The second part reports the focus students' perceptions of the teacher's lesson structure preference and corresponding reasons for such perceptions. Finally, focus students' lesson structure preferences are compared with their perceptions of the teacher's lesson structure preference.

Focus Students' Lesson Structure Preference

From both classes, the focus students' interview responses corroborated their post-lesson drawing task responses. This consistency is likely due to both data sources being completed at roughly the same time as each other and for the same lesson. Of importance is the fact that students seemed to report preferring the lesson structure they had just experienced. Recency is likely a factor for their preference. However, of interest in the current study were their reasons for these preferences and whether their perceptions of the teacher's preference were influential on their preferences.

Six focus students from the class that just finished their first lesson of the final week of teach-first lessons (Class A) reported preferring the teach-first lesson structure more than the task-first lesson structure. Students' reasons for favouring the teach-first structure predominantly included being better equipped for independently solving the challenging tasks that occurred later in the lesson. For example:

> I'd say maybe the mini lesson (teach-first) a bit more because when you start something new at first, you're not so good at it so maybe the mini lesson can help me by giving me more ideas for what I'm going to do. (S9)

By contrast, a few focus students from Class A either preferred the task-first lesson structure ($n = 1$), preferred both lesson structures to the same or a similar extent ($n = 1$), or were unsure of their preferences ($n = 1$). One student preferred the task-first lesson structure because it enabled hard thinking and challenged them: "…But for my opinion, I like sweaty brain time more because I feel it challenges my brain a lot more because it makes me think more and I like thinking hard and challenging my brain" (S3). The student who reported preferring both lesson structures to the same or a similar extent provided a mix of both reasons described above. Figure 2 provides a graph of Class A focus students' lesson structure preferences.
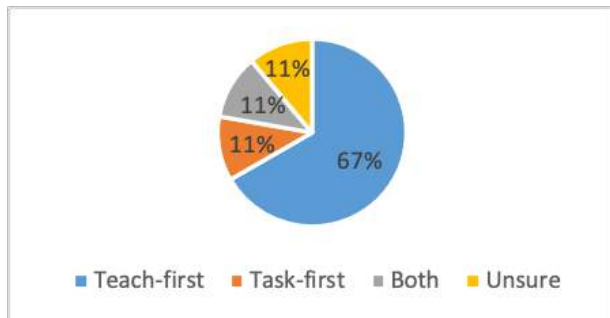
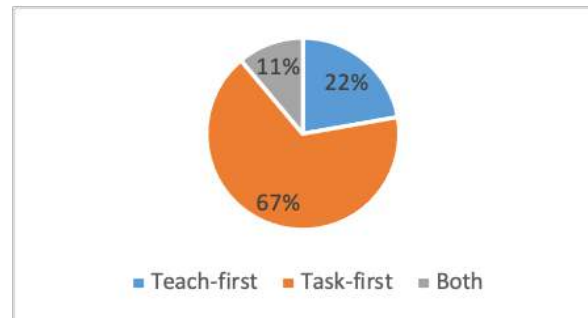Figure 2. Class A focus students' lesson structure preferences.

Figure 3. Class B focus students' lesson structure preferences.

On the other hand, six focus students from the class that had just finished their first lesson of the final week of task-first lessons (Class B) reported preferring the task-first lesson structure more than the teach-first lesson structure. Students' reasons for preferring the task-first lesson structure were similar to the reason provided by S3, but also include opportunities for independent thinking and learning. For example:

> I think the sweaty brain (task-first) lessons because it helps me dig for my own answers and work independently. Because Ms J doesn't give us answers, it makes it more open for us because there's a lot of options, instead of when your teacher shows you some ways to do something because that makes all of your other options shut down. You can put it on paper, discuss it with your teacher, and think about it. (S15)

Unlike the preferences of Class A focus students in which most students preferred the teach-first structure, only two focus students from Class B preferred the teach-first structure more than the task-first structure. The reasons for this preference include the low level of difficulty and the choice to think out loud. As one student indicated:

> I think it is the teach-first because it's easier for me but with sweaty brain time (task-first), it's a bit hard for me to stay quiet for a while. It's hard to think in my head when I can't think out loud. I think the mini lesson is helpful for my learning. (S12)

Furthermore, identical to Class A, one student reported preferring both lesson structures to the same extent with reasons surrounding differing benefits perceived in both lesson structures–teach-first being less stressful but task-first effective for improving your brain. Figure 3 shows Class B focus students' lesson structure preferences.

Overall, students' reasons for their lesson structure preferences resonate with findings by Russo and Hopkins (2017), which revealed students that preferred the teach-first lesson structure considered it to activate their cognition in preparation for solving challenging tasks, while students that endorsed task-first lessons perceived it to be more cognitively demanding.

Focus Students' Perceptions of the Teacher's Lesson Structure Preference

Sixteen focus students developed a variety of opinions around the lesson structure preferred by Ms J. The perceptions of Class A students were almost identical to that of Class B, with the only difference being one more student from Class B perceiving Ms J preferred teaching the task-first lessons, while one less student from the same class perceived Ms J preferred teaching the teach-first lessons. Two students perceived Ms J preferred teaching both lesson structures to the same or a similar extent, while two students did not have an opinion on her preference. Figure 4 provides a graph of Class A focus students' perceptions of Ms J's lesson structure preference and Figure 5 provides a graph of Class B focus students' perceptions of Ms J's lesson structure preference.
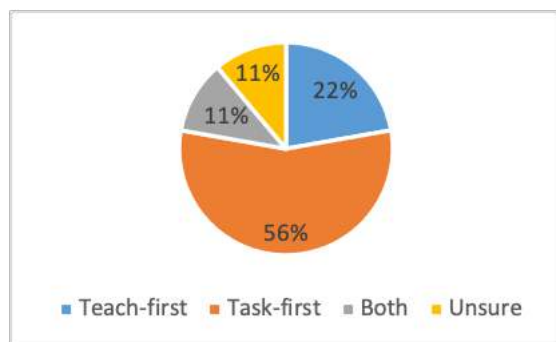
Figure 4. Class A focus students' perceptions of the teacher's lesson structure preference.
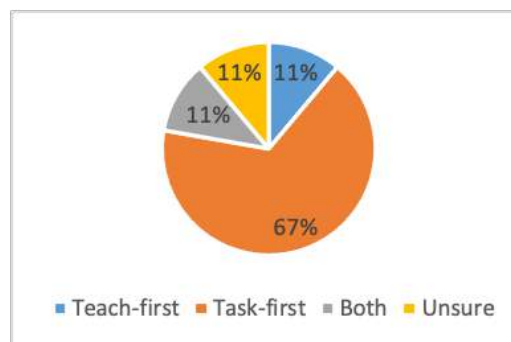

Figure 5. Class B focus students' perceptions of the teacher's lesson structure preference.

When prompted to explain the reasons for Ms J's perceived lesson structure preference, a variety of responses were given. While a few students that perceived Ms J to prefer the task-first lesson structure over the teach-first lesson structure offered reasons that reflect their perceptions of her work-related preferences (e.g., quietness during sweaty brain time, less likely to feel overwhelmed because the students are working more independently, option to talk to her friends while the students work), most students were aware of her reactions towards teaching the task-first lessons (e.g., looking more relaxed, smiling when spotlighting students and listening to their ideas, enthusiasm towards seeing students challenge their own thinking and deepening their learning in the absence of telling answers). One student indicated:

> I think she likes the sweaty brain (task-first) lessons too because every time she goes around, she puts a smile on her face and she always feels very interested about all the ways we're doing things so instead of doing teach-first, she gets to know where we're coming from with our opinion. I noticed she's very excited to learn about our thinking. (S15)

All students that perceived Ms J to prefer the teach-first lesson structure over the task-first lesson structure gave reasons that reflect their perceptions of her work-related preferences (e.g., more involvement with teaching, actively leading the whole class to show students possible solutions and strategies for the problem, keeping occupied during the lesson) but did not notice any display of positive behavioural reactions during those lessons. Such students were perhaps less tuned-in to Ms J's enjoyment. As described by one student: "I think she prefers teaching the teach-first because she can explain to us and she has something to do during class. But during task-first, she doesn't get to explain anything except fishbowls which the children explain themselves" (S14). The data shows that Year 3 and 4 students are insightful enough to notice what the teacher prefers and enjoys. Corresponding with findings from Frenzel et al. (2017), there seems to be a positive link between the reasons given for the students' lesson structure preferences, and the reasons given for Ms J's lesson structure preference. Despite a relatively small number of students not having an opinion, most students believed they figured out what Ms J felt was more enjoyable to teach.

Focus Students' Lesson Structure Preferences and their Perceptions of the Teacher's Lesson Structure Preference

From Class A, a slightly larger number of focus students shared the same or a similar lesson structure preference as Ms J (*n* = 4). Included in this data are students who presented reasons for preferring both lesson structures and/or perceiving Ms J to prefer both lesson structures. The remaining students either had a different preference from Ms J (*n* = 3) or did not have an opinion on either their own lesson structure preference or Ms J's lesson structure preference (*n* = 2). Figure 6 shows a graph comparing Class A focus students' lesson structure preferences with their perceptions of Ms J's lesson structure preference.
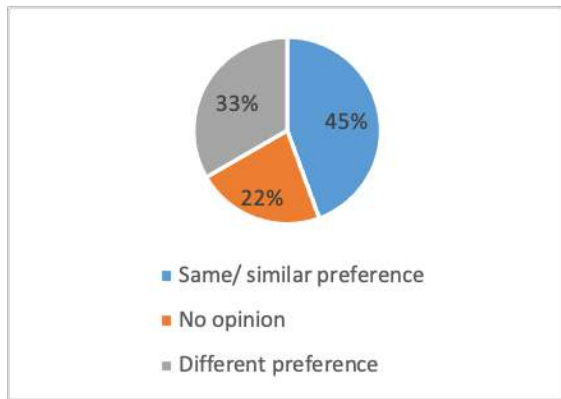
Figure 6. Comparison of Class A focus students' preferences and their perceptions of the teacher's preference.
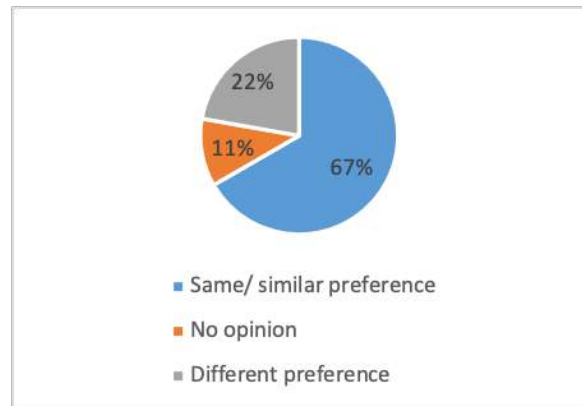

Figure 7. Comparison of Class B focus students' preferences and their perceptions of the teacher's preference.

From Class B, an even larger number of focus students shared the same or a similar lesson structure preference as Ms J ($n = 6$). This data includes the student that presented reasons for perceiving Ms J to prefer both lesson structures. The remaining students either had a different preference from Ms J ($n = 2$) or did not have an opinion on her preference ($n = 1$). A graph representing the comparison between Class B focus students' lesson structure preference and their perceptions of Ms J's lesson structure preference is represented in Figure 7.

Interestingly, of the focus students that formed an opinion, 10 reported favouring the same lesson structure as they perceived Ms J did. Given the prevalence of students preferring the same lesson structure that they perceived their teacher preferred, it is possible that students' preferences were influenced by their perception of Ms J's lesson structure preference. This possibility resonates with Pekrun's (2000) control-value theory of achievement emotions, which claims that emotional experiences are affected by individuals' perceptions of their interaction partners' behaviours. Because students from both classes participated in both lesson structures across both topics throughout the intervention, students' preferences towards the lesson structure itself may have only partially contributed to their opinion. Perhaps some students preferred and enjoyed a particular lesson structure because they perceived their teacher to prefer and enjoy teaching it. As established in findings by Frenzel et al. (2017), there is a positive reciprocal relationship between the teacher's enjoyment and the students' enjoyment which are noticed through observations of each other's classroom behaviours.

Conclusion

This study aimed to explore in-depth the reasons for the students' preference for a lesson structure based on how it supported their learning, and whether their perceptions of the teacher's preference for a lesson structure appeared to influence their own preference. Overall, the results suggest that students preferred either the teach-first or task-first lesson structure for various reasons relating to perceived benefits to their learning, that most students had formed an opinion on their teacher's lesson structure preference, and that there seems to be a positive reciprocal relationship between the lesson structure the students enjoy and what they perceive their teacher to enjoy. While limitations of this study include a small number of students who were either frequently absent, unable to form an opinion and/ or provide informative and sensible responses, the majority of students were aware of their perceptions. Therefore, implications of this study include the importance of teachers knowing that their own enjoyment of teaching a lesson can inadvertently influence their students' enjoyment of mathematics.

Acknowledgements

References

Bakker, A. B. (2005). Flow among music teachers and their students: The crossover of peak experiences. *Journal of Vocational Behavior, 66*(1), 26–44. https://doi.org/10.1016/j.jvb.2003.11.001

Becker, E. S., Goetz, T., Morger, V., & Ranellucci, J. (2014). The importance of teachers' emotions and instructional behavior for their students' emotions—An experience sampling analysis. *Teaching and Teacher Education, 43*, 15–26. https://doi.org/10.1016/j.tate.2014.05.002

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Csikszentmihalyi, M. (1997). *Finding flow: The psychology of engagement with everyday life* (1st ed.). BasicBooks.

Frenzel, A. C., Becker-Kurz, B., Pekrun, R., Goetz, T., & Lüdtke, O. (2017). Emotion transmission in the classroom revisited: A reciprocal effects model of teacher and student enjoyment. *Journal of Educational Psychology, 110*(5), 628–639. https://doi.org/10.1037/edu0000228

Frenzel, A. C., Goetz, T., Lüdtke, O., Pekrun, R., & Sutton, R. E. (2009). Emotional transmission in the classroom: Exploring the relationship between teacher and student enjoyment. *Journal of Educational Psychology, 101*(3), 705–716. https://doi.org/10.1037/a0014695

Keller, M. M., Hoy, A. W., Goetz, T., & Frenzel, A. C. (2016). Teacher enthusiasm: Reviewing and redefining a complex construct. *Educational Psychology Review, 28*(4), 743–769. https://doi.org/10.1007/s10648-015-9354-y

Martin, A. J., Way, J., Bobis, J., & Anderson, J. (2015). Exploring the ups and downs of mathematics engagement in the middle years of school. *The Journal of Early Adolescence, 35*(2), 199–244. https://doi.org/10.1177/0272431614529365

Pekrun, R. (2000). A social-cognitive, control-value theory of achievement emotions. In J. Heckhausen (Ed.), *Motivational psychology of human development* (pp. 143–163). Oxford, UK: Elsevier. http://dx.doi.org/10.1016/S0166-4115(00)80010-2

Polkinghorne, D. E. (2005). Language and meaning: Data collection in qualitative research. *Journal of Counselling Psychology, 52*(2), 137–145.

Renninger, K. A., & Hidi, S. (2016). *The power of interest for motivation and engagement*. New York, NY: Routledge. https://doi.org/10.4324/9781315771045

Russo, J., & Hopkins, S. (2017). How does lesson structure shape teacher perceptions of teaching with challenging tasks? *Mathematics Teacher Education and Development, 19*(1), 30–46.

Russo, J., & Hopkins, S. (2019). Teaching primary mathematics with challenging tasks: How should lessons be structured? *The Journal of Educational Research, 112*(1), 98–109. https://doi.org/10.1080/00220671.2018.1440369

Sullivan, P., Bobis, J., Downton, A., Hughes, S., Livy, S., McCormick, M., & Russo, J. (2020). Ways that relentless consistency and task variation contribute to teacher and student mathematics learning. In A. Coles (Ed.) *For the learning of mathematics monograph 1: Proceedings of a symposium on learning in honour of Laurinda Brown* (pp. 32–37). FLM Publishing Association.

Sullivan, P., Borcek, C., Walker, N., & Rennie, M. (2016). Exploring a structure for mathematics lessons that initiate learning by activating cognition on challenging tasks. *The Journal of Mathematical Behavior, 41*, 159–170. https://doi.org/10.1016/j.jmathb.2015.12.002