

Pedagogic Identity and Maths Talk in the Early Years: A Study of Two Teachers

Carol Murphy

University of Tasmania
carol.murphy@utas.edu.au

Tracey Muir

Australian Catholic University
tracey.muir@acu.edu.au

Damon Thomas

University of Queensland
damon.thomas@uq.edu.au

The introduction of pedagogic strategies to support student talk in mathematics classrooms has had varying success. This study explored the pedagogic identity of two teachers within a professional development project aimed at developing student talk in early years mathematics. Interview data with the two teachers were analysed deductively according to Lefstein's four dimensions of dialogic teaching and related to pedagogic identity. Findings revealed contrasting ideologies that influenced the teachers' adoption of talk strategies and suggest that, to sustain changes in student talk, teacher pedagogic identities should be recognised and accommodated.

Studies have shown that, when students' awareness of talk in learning is raised and they engage in content specific reasoned discussions, then the quality of group activity and learning outcomes are greatly improved (e.g., Howe et al., 2019) leading to a consensus that type of classroom talk impacts on student learning (Bouton & Asterhan, 2023). However, professional development (PD) to develop productive dialogue is not always successful (Moser et al., 2022; Vrikki et al., 2019). Within mathematics classrooms, many factors, including competing goals, student background, and the uncertainties of both teachers and students, impact on changes to classroom practice (O'Connor & Michaels, 2019). Maass (2011) has further indicated that teacher beliefs can limit potential changes. What is less clear is how such beliefs and factors can be further understood, particularly in early years mathematics classrooms. Understanding and accommodating these beliefs and factors may help to adapt PD programmes and support teachers in developing use of productive talk in their classrooms.

In this research report, we present data from our larger project, *Talking Maths*, that involved the design and implementation of a professional development (PD) programme to promote young students' talk and learning in mathematics. We determine how the perspectives of two teachers influenced their capacity to promote and sustain talk in early years mathematics classrooms. Specifically, we refer to pedagogic identity as the beliefs, perspectives and pedagogical experiences of the teachers (Hong et al., 2024; Murphy, 2015) and ask the question: To what extent can pedagogic identity function as a theoretical lens for understanding the tensions in sustaining productive talk in mathematics classrooms?

Literature Review

The relevance of talk on student learning in the classroom has been promoted by academics such as Alexander (2008) who defined dialogic teaching as teaching that focuses on talk that engages student interest, stimulates thinking, and advances understanding. Authenticity, response, and cognitive demand are seen to be inherent qualities of dialogue. These qualities of dialogue contrast with the often prevailing Initiation-Response-Feedback (IRF) model (Sinclair & Coulthard, 1975), where the teacher initiates a question, the student provides a response, and the teacher follows with feedback.

Supporting students' talk in the mathematics classroom, both whole class and in collaborative groups, requires scaffolding. There has been much interest in how experienced

(2026). In N. Berger, M. Thompson, J. Ley & C. Wilsmore (Eds.), *Beyond boundaries: Strengthening futures in mathematics education. Proceedings of the 48th annual conference of the Mathematics Education Research Group of Australasia*, Sydney (pp. 281–288). MERGA.

teachers manage such scaffolding while maintaining students' ownership of their own thinking (e.g., Klemp, 2020; Murphy et al., 2025). Other literature has provided support on the use of prompts and ground rules for small group work (Mercer & Sams, 2006) and the use of talk moves in supporting teachers to take up productive talk in whole class teaching (O'Connor & Michaels, 2019).

The availability of literature presenting support structures for teachers, for example Talk Moves (Anderson et al., 2011) and Number Talks (Parrish, 2010), has provided evidence that interventions based on practical strategies can impact on teachers' practice and dialogue in mathematics classrooms. Nevertheless, there remains a scarcity of productive talk in mathematics (Moser et al., 2022). PD has not always been successful, with potential factors such as time constraints, teacher familiarisation of dialogic principles, and the need to provide tools to support teachers in supporting and sustaining student talk both whole class and in group work. What has not always been considered is the teacher's capacity in extending talk in their classroom to move beyond sharing strategies towards cumulative student contributions (Ni et al., 2021). A further consideration relates to a teacher's view of mathematics and their role in relation to their authority as a teacher of mathematics (Campbell & Teo, 2022). Such findings suggest that "doing" PD (Heyd-Metzuyanim et al., 2018) is not always sufficient in countering misalignment between PD intentions and teachers' practices. These findings point towards the impact of teachers' capacity, views of mathematics, and their perceived role in teaching mathematics on alignment or misalignment with the PD intentions. Our premise is that anticipating and accounting for these elements in relation to pedagogic identity can help in understanding and addressing potential misalignment.

Theoretical Perspectives

While teacher instruction is recognised as social, this social notion has contrasting ideologies (Walkerdine, 1990). Much of the literature underpinning PD on talk in the classroom draws on theories related to dialogic practice (e.g., Alexander, 2008). Based on Vygotsky's (1978) sociocultural perspective, collaborative and joint reasoning are determined through the intermental plane of cognition and the genesis of intramental functioning. In this way, classroom talk happens on a social plane and acts as the conduit to the individual plane of a student. Such an ideology relates to non-positivist viewpoints where mathematics is seen as generative meaning making. Talk in the classroom is not about acquiring a set of mathematical structures but is about meaning making through negotiation of ideas and recognises that "discursive contributions that may pull others forward into their increasing participation in mathematical speaking/thinking" (Lerman, 2001, p.89). This non-positivist viewpoint is intrinsic to dialogic practice. In contrast, a positivist viewpoint does not recognise the social nature of knowledge and learning in the same way. A positivist structuralist ideology suggests mathematical knowledge is static and stable. Whilst teaching is still seen as a social practice, the teacher tells the students what they need to know.

An important element of these contrasting ideologies is the teachers' own perspectives, that is their identity (beliefs and perceived confidence) and experiences towards mathematics pedagogy (Murphy, 2015). As such, teaching practices are seen as "enactments of an individual's combined teaching identity and experiences" (Hong et al., 2024, p. 308). In this way, a teacher's pedagogic identity is interpreted as their sense of self, that is their knowledge, beliefs and interests as much as their professional experiences and development. Furthermore, a teacher's pedagogic identity may be swayed by perceptions of policy directives and the expectations of themselves as teachers. In addition, practices may "thicken" as teacher experiences and PD accumulate (Cribbs & Utley, 2024). In these regards, identity is defined at a specific time and determines how teachers understand their own practice within a given context (Hong et al., 2024). It is within a specific context, parallel early years Australian

classrooms, that we investigated how two teachers evaluated the implementation of the PD to support student talk in mathematics.

Research method

In this research report, we focus on two teachers in the same school that were involved in the project for one school year. The two teachers, Helen and Edith (pseudonyms) taught grade one and grade two students (six- to seven-year-olds) at a school situated in a low socio-economic area in a regional Australian city. Helen had been teaching in the primary sector for ten years but had recently transferred to teaching this younger age range. Edith had twenty years teaching experience in various roles with six years teaching this age range. Helen taught full-time and Edith taught part-time at the school.

The PD was delivered across five workshops. Workshop one focused on classroom discourse norms and drew on pedagogical strategies to promote students' confidence to speak and willingness to engage and listen to others through short partner work and whole class repeating, reporting, and revoicing. Workshop two introduced talk prompts for group work directed by the teacher as part of whole class teaching. Workshop three extended the use of the talk prompts to independent small group work and short challenging tasks. Workshop four consolidated talk within collaborative group work as part of the intended curriculum content. Workshop five focused on evaluation across the PD.

A range of data were collected as part of the larger project. Data used in this research report were gathered through paired semi-structured interviews in each of the five workshops. The agenda for the interview in workshop one focused on teaching experiences, including any previous PD, and reasons for joining the project. Further questions related to their perceived proficiency in teaching mathematics and their approach to teaching. Interviews in workshops two to five focused on the two teachers' self-reported experiences when introducing the phased talk strategies in their classrooms. Interviews were managed as conversations between the interviewer and the two teachers. Whilst the interviewer followed a semi-structured protocol, the teachers extended their conversations as a pair, allowing them to make sense of their teaching practice and of their experiences in implementing phases of the PD. In that way, the data present as teacher narratives and the interviewer lived the story with the teachers (Clandinin & Caine, 2008).

Teacher narratives were analysed deductively. Themes for the analysis of workshop one interview relate to key elements from identity literature: previous experiences (Hong et al., 2024); reported levels of confidence (Cribbs & Utley, 2022); and teachers' understanding of their own practice (Hong et al., 2024). Analysis of workshops two to five focused on the successes and tensions that the teachers experienced and we relate these to Lefstein's (2010) dimensions. Lefstein posited that aspects of school practice may constrain the way that dialogue is conducted and are not always commensurate with idealistic models of dialogic teaching. Based on this premise, Lefstein presented four dimensions that recognise the inherent tensions between teacher-student and student-student dialogue in classrooms: 1) Metacommunicative – “the nature of the conversation itself” and “dialogue as interactional structure” (p.173); 2) Interpersonal – non-cognitive, emotional relations perspective and how “personal animosity can obstruct or derail dialogue's progress” (p.173); 3) Ideational – cognitive activity as a means of learning between two or more people's thoughts or perspectives or understandings; 4) Aesthetic – setting the scene for engagement in relation to the topic and activity as well as the space and organisation with the classroom. Accepting rather than ignoring these tensions and constraints are useful in understanding the nature of dialogue. In the discussion, we determine each teachers' pedagogic identity and relate to their experiences in managing the tensions and constraints of the four dimensions.

Results

Workshop One Interview: Pedagogic identities

Previous experiences

The last PD that Edith had attended in mathematics was six years ago. She felt that she had mostly forgotten the training and that it no longer impacted on her teaching. Helen attended PD in teaching early numeracy through structured inquiry two years ago and she continued to work with the approach. Both teachers referred to a lack of consistency and guidance in teaching mathematics. They felt that they were finding their own way and that the “landscape of teaching math... has chopped and changed so much” (Helen) and that “it feels quite a jumble of what I’m putting into the teaching” (Edith).

Reported levels of confidence

Edith indicated that mathematics was not her favourite subject to teach, admitting that “sometimes I feel like a fool.” She felt she had missed a lot of the “first steps” in her own mathematics and how that had “carried through” into her own teaching. She further suggested that “I feel like my explanations with maths are really not that great.” Helen also expressed some reticence stating that “I don’t think I’m bad at teaching maths...I’m just not sure yet.” She saw her recent move to early years mathematics as a shift to a pedagogy that is “far more concrete, far more explicit in many ways... And you kinda just go... I think I’m doing this right.”

Understanding of their own practice

Edith indicated that she liked “prescribed things, ‘cause math is not something I’m particularly strong with...” She further indicated that she was keen to see what the children could do as individuals “I’m gonna give you a task. I’ll see if you can do it. Here’s me explaining it to you... and here’s the job that I want to see [what you can do].” As such, Edith had used little shared talk with her students. Helen referred to her promotion of inquiry through collaboration, participation and differentiation saying, “You’re not doing the talking they are, they’re sharing strategies, they’re building on each other’s strategies.” These perspectives in relation to sense of self were further reflected in the teachers’ reasons for joining the project. Helen indicated that she wanted “to build quality practice in teaching maths” and to “develop skills to empower students and for them to feel confidence in mathematics.” Edith indicated that she wanted “just to” improve her mathematics instruction by gaining confidence and “to explain to my children and making sure I’m using language that they understand.”

Workshops Two to Five Interviews: Dialogic Dimensions

Metacommunicative: Dialogue as Interactional Structure

Both teachers reflected on the introduction of talk prompts to be used by the students in small groups. Edith felt that the way she had presented them (“I just wrote mine out very plain”) was insufficient as the students did not use them directly but that they may have reminded them to ask questions in their group. Helen had been more proactive. “I’d have to go around and kind of say ... well, I don’t agree with that. Well, what do you need to do?” This reminded students to hold up the talk prompt and become more confident in using the language. Further to this, Helen monitored students’ use of questions “Have you used the prompts? Are you sharing the knowledge? Are you teaching this person?” She also modelled the language in whole class contexts. “So we’d have solutions on the board... and we’d talk about, well, how did you come up with this?... What do we notice here?” Helen endeavoured to break a habit of taking turns, prompting students with “You are doing it together... Well, that was his answer. And I will say, well, no, because you’re a group so this is a group answer.”

Interpersonal: Dialogue as relation

Edith noticed that the students enjoyed “the opportunity to work with somebody to do maths ... to talk and share their ideas.” She further noted that they “were listening to each other, and there was a real willingness to engage.” Helen also referred to students’ sharing of knowledge, confidence to speak, and listening to each other. Helen further indicated how “Every partner gets to share and that students cannot hide. You’re accountable to your partner, and you’re accountable to the class and to me.” In workshop three, Edith and Helen discussed how the groups were composed. Helen noticed that students often chose partners they felt comfortable to challenge “in a safe pairing” and where they could “have a go without worrying about being wrong.” Edith also commented that “they’re in a safe environment with children with similar abilities.” However, both Edith and Helen noticed that some students did not choose partners based on trust but on support, where a more able student would do the mathematics for them. Edith commented that the stronger mathematician would be “taking the lion’s share” and that this pattern had not been broken.

Ideational: Dialogue as cognitive activity

Helen reported how the group work supported students’ learning.

When we come back to share ... a lot of the children who didn’t come up with the answer are still able to explain what the other person has done.... [they] obviously felt confident enough to kind of say, well, hang on, are these the right numbers?

Edith, however, felt less certain that her students were able to consider other perspectives, and that they would “Default to something that they know... They couldn’t look at it any other way...” Both teachers indicated a disparity between the students’ skill in the mathematics and their ability to explain the mathematics. Edith suggested students may have been hindered by their language level “only the more articulate students could do this.” Helen observed how going beyond an explanation to justify their mathematics was problematic. “If they explain it and ... people ask questions, they don’t know how to go that bit further.” Helen further observed that some students “just do not have the social skills to actually understand that they are in a group and it’s not all about them.” She commented that “grade ones are really only just starting to learn how to actually explain what they’ve done.”

Aesthetic: Setting the scene for engagement

Both teachers discussed how their choice of questions and activities could create or limit opportunities for talk. Edith referred to finding “the right level of questions” commenting “it’s hard to get that meatiness of not too much and not too little.” Helen also noted that it was important to get the right stimulus. “When something’s easy, kids will say, I just know. And they do ... they know the concept really well. And so, when you say, how do you know? It’s not a challenge for them, so they don’t have to think about their thinking.” Edith further commented on the nature of the mathematics. “Maths does require that system, ... to be methodical about it.” Students “get frustrated when those answers are not there in their minds straight away, ... like they don’t necessarily want to have to work for those answers.” Edith further considered how her students were reliant on working with closed questions. “That’s what they’re expecting.” She then related to her aims in teaching, indicating that “I’m always trying to drive towards what I think is correct. So, I think I’m in that mindset.” She then added “Do I need to sort of not do that?” Helen’s perspective suggested a contrast. “I love wrong answers because then we get to talk about them. We can say, who agrees? Who doesn’t agree? Great. Tell me more.” She indicated that her students seemed resilient in managing this “I’ve never had a kid upset about that ... I thought it was right, but we come to a shared understanding. And the kids are all like, yeah, we solved it. It was great.”

Both teachers commented on time pressures in managing the monitoring of the talk in groups. Edith referred to getting “very stuck in that housekeeping of just making sure everyone actually looks like they’re okay” and admitted that she needed “to get down and really listen to these children.” Helen also noted that it was “tricky to get around all the groups, ... you certainly didn’t have time to get around all the groups. You just kind of had to trust, in some ways, they were actually holding each other accountable.”

Discussion

In the discussion, we consider each teachers’ pedagogic identity and relate these to their different experiences in implementing the PD and sustaining productive talk in the two parallel classrooms. Three elements of the two teachers’ pedagogic identity - experiences and context; level of confidence; and understanding of their own practice - are critiqued in relation to Lefstein’s dimensions - Metacommunicative, Interpersonal, Ideational, and Aesthetic. This critique is used to determine the extent to which the pedagogic identity helps to understand how the tensions and constraints were experienced by the two teachers.

In relation to the Aesthetic dimension and opportunities for student engagement, both teachers suggested some lack of confidence in teaching mathematics, Edith in relation to her own learning experiences and Helen due to lack of consistency in pedagogical approaches. Helen’s more recent PD had focused on structured inquiry (e.g., Stein & Smith, 2011), suggesting she was more familiar with the authentic nature of dialogic teaching (Alexander, 2008). Further to this, Helen referred to the constructive use of wrong answers with her students suggesting an epistemological non-positivist viewpoint of meaning making, recognising the potential to create openings for dialogue in her classroom. She appeared to aim for discursive contributions in the way that Lerman (2001) had suggested by pulling her students into the classroom discourse. This viewpoint is further reflected in her aim to empower students in their learning. As such, Helen experienced fewer tensions in realising the Aesthetic dimension. In contrast, Edith’s interview responses suggested her practice was more aligned with the IRF model (Sinclair & Coulthard, 1975) as defined in the introduction. She further expressed a view that mathematics requires systems, suggesting an epistemological positivist viewpoint where mathematics is static and stable (Walkerdine, 1990). She focused on closed questions and was concerned for her students’ frustration in not getting to the correct answer. As such, Edith experienced greater tensions in realising the Aesthetic dimension. Nevertheless, she felt that her teaching had become less formal, suggesting a change in her practice. She also questioned her mindset in asking whether she needed to always “drive towards what was correct”.

In relation to the Metacognitive dimension, Helen seemed confident in scaffolding the use of the talk strategies. She modelled and reinforced the use of the talk prompts and felt that the students had moved to their own spontaneous questioning in their group work. Edith, however, seemed to have been less proactive in modelling the use of prompts. Nevertheless, she felt the prompts had acted as a physical reminder and that the students did engage in paired work. It is possible that Edith’s lack of confidence and limited familiarity in dialogic practices hindered her scaffolding. A further possibility is that Edith was concerned with time constraints as she was employed part-time, hence, she may have had less opportunity to scaffold the use of the prompts. Nevertheless, Edith was finding her own ways to adopt the strategies into her teaching within the limitations of her experiences and her employment.

In relation to the Ideational dimension, Edith’s positivist perspective led to an interpretation of cognitive activity as being pertinent to the students’ own knowledge, rather than a student appreciating another student’s perspective. Furthermore, Edith noted that strong mathematicians often dominated the mathematics talk. On the other hand, Helen’s non-positivist perspective related to an interpretation of cognitive activity as an act of taking on another student’s mathematical thinking. Such an act would then enable a student to question

their own thinking in determining meaning making. Her aim was for students to become accountable to each other rather than acting individually or allowing one student to dominate.

In relation to the Interpersonal domain, both teachers experienced similar successes. They both reported that their students enjoyed sharing their mathematics and were willing to engage in talk in pairs or small groups. However, they both experienced similar contextual tensions relating to the young students' language and social abilities. The issue of time restrictions was also common to both. Such contextual tensions were common to the pedagogic identity of both teachers in the study.

Concluding remarks

The findings suggest that curriculum context, time pressures, and the social and language abilities of young students limited opportunities for both teachers to move beyond reporting and revoicing to encouraging students to justify their own thinking. However, further to these common constraints, the findings suggest that the two teachers' contrasting ideologies, evident through the interview conversations in the workshops, played a substantial role in each teachers' implementation of the PD programme. Helen's non-positivist ideology and her aim to empower students to be accountable contrasted with Edith's positivist ideology in working towards method and correct solutions. These contrasting ideologies were essential to the pedagogic identities of the two teachers. Nevertheless, Edith suggested her teaching had become less formal and that her students enjoyed sharing their mathematics. Involvement in the PD may have "thickened" her practice (Cribbs & Utley, 2024) which, in turn, may have influenced aspects of her pedagogic identity.

In conclusion, we suggest that, in this study, pedagogic identity functioned as a theoretical framework in understanding the tensions in promoting and sustaining productive talk in the two teachers' early years mathematics classrooms beyond the common constraints. Further to previous studies that focused on contextual constraints and teacher capacity (e.g., Campbell & Teo, 2022; Moser et al., 2022; Ni et al., 2021), we propose that recognising the alignment or misalignment of teachers' pedagogic identities with PD intentions helps to understand the tensions experienced by different teachers. Recognising pedagogic identities suggests a shift from "doing" PD to accommodating differing pedagogic identities with the potential to help teachers adapt to new practices. Beliefs may be hard to change (Maass, 2011) but, by incorporating new practices, teachers' pedagogic identity can further develop.

We note that the findings in this research report are drawn from teacher self-reporting. Whilst such reporting can reveal teacher perceptions, they do not confirm classroom practice. Analysis of the classroom observation data is desirable in substantiating any claims. Investigations are underway, involving the larger project's classroom video data, to further determine the claims of the study presented in this research report.

Acknowledgments

We acknowledge funding from the Australian Research Council DP220102744.

Ethics approval H0027147 was granted by the University of Tasmania and school principals, teachers and parents/caregivers gave informed consent.

References

- Alexander, R. (2008). Culture, dialogue and learning: Notes on an emerging pedagogy. In N. Mercer & S. Hodgkinson (Eds.) *Exploring talk in school: Inspired by the work of Douglas Barnes* (pp. 91-114). Sage. <https://doi.org/10.4135/9781446279526.n6>
- Anderson, N., Chapin, S., & O'Connor, C. (2011). *Classroom discussions in math: A facilitator's guide to support professional learning of discussion and the common core*. Scholastic Inc.

- Bouton, E., & Asterhan, C. (2023). In pursuit of a more unified method to measuring classroom dialogue: The dialogue elements to compound constructs approach. *Learning, Culture and Social Interaction*, 40, 100717. [10.1016/j.lcsi.2023.100717](https://doi.org/10.1016/j.lcsi.2023.100717)
- Campbell, T., & Teo, S. (2022). Professional noticing of coordinated mathematical thinking. *British Educational Research Journal*, 48, 488-509. <http://dx.doi.org/10.1002/berj.3778>
- Clandinin, D. J., & Caine, V. (2008). *Narrative inquiry. The Sage encyclopedia of qualitative research*. Sage.
- Cribbs, J., & Utley, J. (2024). Exploring K-12 mathematics teachers' identity and beliefs about mathematics and teaching. *Mathematics Teacher Education and Development*, 26(1), Article 5.
- Klemp, T. (2020). Early mathematics – teacher communication supporting the pupil's agency. *Education 3-13*, 48(7), 833-846. <https://doi.org/10.1080/03004279.2019.1663893>
- Heyd-Metzuyanim, E., Munter, C., & Greeno, J. (2018). Conflicting frames: A case of misalignment between professional development efforts and a teacher's practice in a high school mathematics classroom. *Educational Studies in Mathematics*, 97, 21-37. <http://dx.doi.org/10.1007/s10649-017-9777-0>
- Hong, J., Cross Francis, D., & Schutz, P. A. (2024). Reconceptualizing teacher identity development. *Educational Psychologist*, 59(3), 159-176. <https://doi.org/10.1080/00461520.2023.2292713>
- Howe, C., Hennessy, S., Mercer, N., Vrikki, M., & Wheatley, L. (2019). Teacher-student dialogue during classroom teaching: Does it really impact upon student outcomes? *Journal of the Learning Sciences*, 28(4-5), 462-512. <https://doi.org/10.1080/10508406.2019.1573730>
- Lefstein, A. (2010). More helpful as problem than solution: Some implications of situation dialogue in classrooms. In K. Littleton & C. Howe (Eds.) *Educational dialogues* (pp. 182-203). Routledge. <https://doi.org/10.4324/9780203863510>
- Lerman, S. (2001). Cultural, discursive psychology: A sociocultural approach to studying the teaching and learning of mathematics. *Educational Studies in Mathematics*, 46, 87- 113. <http://dx.doi.org/10.1023/A:1014031004832>
- Maass, K. (2011). How can teachers' beliefs affect their professional development? *ZDM-Mathematics Education* 43, 573–586. <https://doi.org/10.1007/s11858-011-0319-4>
- Mercer, N. & Sams, C. (2006). Teaching children how to use language to solve maths problems. *Language and Education*, 20(6), 507-528. <https://doi.org/10.2167/le678.0>
- Moser, M., Zimmermann, M., Pauli, C., Reusser, K., & Wischgoll, A. (2022). Student's vocal participation trajectories in whole-class discussions during teacher professional development. *Learning, Culture and Social Interaction*, 34, 100633. <https://doi.org/10.1016/j.lcsi.2022.100633>
- Murphy, C. (2015). Changing teachers' practices through exploratory talk in mathematics: As discursive pedagogical perspective. *Australian Journal of Teacher Education*, 40(5), 61-84. <http://ro.ecu.edu.au/ajte/vol40/iss5/4>
- Murphy, C., Muir, T., & Thomas, D. (2025). Scaffolding collaboration in early years mathematics: A practice-based case study in teaching multiplicative grouping. *Early Childhood Education Journal*, 53, 3207-3217. <https://doi.org/10.1007/s10643-025-01928-5>
- Ni, Y., Shi, L., Cheung, A., Chen, G., Ng, O-L., & Cai, J. (2021). Implementation and efficacy of a teacher intervention in dialogic mathematics classroom discourse in Hong Kong primary schools. *International Journal of Educational Research*, 107, 101758. <https://doi.org/10.1016/j.ijer.2021.101758>
- O'Connor, C., & Michaels, S., (2019). Supporting teachers in taking up productive talk moves: The long road to professional learning at scale. *International Journal of Educational Research*, 97, 166-175.
- Parrish, S. (2010). *Number Talks: Helping children build mental math and computation strategies, Grades K-5*. Heinemann Educational Books.
- Sinclair, J. M., & Coulthard, R. M. (1975). *Towards an analysis of discourse: English used by teachers and pupils*. Oxford University Press.
- Stein, M. K., & Smith, M. (2011). *Five practices for orchestrating productive mathematics discussions*. National Council of Teachers of Mathematics.
- Vrikki, M., Wheatley, L., Howe, C., Hennessy, S., & Mercer, N. (2019). Dialogic practices in primary school classrooms. *Language and Education*, 33(1), 85–100. <https://doi.org/10.1080/09500782.2018.1509988>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Walkerdine, V. (1990). *The Mastery of Reason: Cognitive development and the production of rationality*. Routledge.