Purposeful Maths Talk: Intentions, Enactments and Tensions

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Abstract

This paper focuses on mathematical talk as a core practice for promoting reasoning, sensemaking, and collaboration. Drawing on sociocultural theories of classroom discourse and empirical data from research, this paper explores how teachers facilitate purposeful talk in classrooms and how their questioning, wait time, and framing of contributions influence the mathematical quality of dialogue. The paper highlights promising shifts in teacher practices but also identifies enduring challenges, such as managing competing discourses of correctness and efficiency.

Keywords: *Math Talk Framework, Primary Maths Curriculum, classroom discourse, dialogue, classroom culture*

Introduction

'How' teachers teach is as important as 'what' they teach. Maths Talk is one of the five pedagogical practices embedded in the *Primary Mathematics Curriculum* (PMC) to enhance and support learning. These pedagogical practices are recognised as fundamental to delivering high-quality mathematical experiences (NCCA, 2024). Rooted in international research, the practices embody the PMC's fresh vision for children's mathematical learning that is characterised by playfulness, creativity, challenge, risk-taking, collaboration and opportunities for reasoning and solving real-life problems (NCCA, 2024).

Theoretical Foundations of Maths Talk

Constructivist and sociocultural theories of learning highlight the central role of language in fostering young children's mathematical understanding [18, 31, 2], each of whom investigate how social forms of interaction influence individual cognition. A Bakhtinian approach suggests that something powerful happens when one human voice interacts with another in that "it always creates something that never existed before, something absolutely new and unrepeatably" [2, 27]. Similarly, according to Vygotsky [31], students first acquire knowledge in their interactions with others.

More recent theoretical developments further underscore the significance of mathematical discourse as a medium through which learners construct mathematical knowledge [26]. Sfard [26] introduces the notion of "commognition," a blend of communication and cognition, to highlight how thinking is formed through participation in specific discursive practices. Taken together, these perspectives converge on the view that structured, purposeful talk in mathematics classrooms is essential for developing both conceptual understanding and mathematical identity.

Defining Mathematical Talk in the Classroom

Dunphy et al. [9] describe Maths Talk as the *"language interactions that occur when children are supported in talking about their mathematical thinking, including their formal and informal representations of mathematical ideas and symbols."* This definition highlights the importance of scaffolding children's verbal expression of both conceptual understanding and symbolic reasoning. Similarly, Hufferd-Ackles, Fuson, and Sherin [12] conceptualise Maths Talk as classroom

"conversations" centred on *"mathematical thinking and reasoning,"* emphasising its role in creating a discursive learning environment. Sztajn et al. [30] broaden this understanding by incorporating key communicative practices such as *"questioning, explaining, and listening,"* thereby framing Maths Talk as a collaborative process that requires active participation from both teachers and learners. Together, these definitions underscore the idea that Maths Talk is not merely about speaking, but about constructing meaning, justifying reasoning, and engaging critically with mathematical content through shared discourse.

Benefits of Mathematical Discourse

There is now a rapidly growing amount of recent research, which shows that maths talk is an important factor to consider in mathematical development [20]. Woods [32] study in this field carefully examined the benefits of students working collaboratively together. Yackel & Cobb [32] highlight the "intellectual autonomy" which is fostered when students work collaboratively together. Similarly, Wagganer's [31] study of Math Talk communities revealed working collaboratively helped students "learn from each other, and we get to help others learn". The advantages of creating such an environment are also highlighted in the work of Hufferd-Ackles, Fuson, & Sherin [12] which revealed that Maths Talk communities allow students to be active participants in their learning and provides opportunity to learn from each other.

Over the course of building a Maths Talk community, Saylor and Walton [25] found that the benefits of Maths Talk are not limited to just the students, but adults as well. Saylor and Walton [25] worked with seven female, childhood education, teachers to create math talk communities to grow the teachers' understanding of mathematics and math-talk communities. At the beginning of the semester, the math talk learning community was established. They introduced the math talk learning community approach to students as an evidence- based way to utilize classroom discourse to enhance students' mathematical learning. The study revealed that after participating in the study, all the teachers made strides in their understanding of the maths talk learning community as a pedagogical approach and many had experienced 'aha' moments in their own understanding of mathematical concepts" [25].

These findings were also mirrored in the research conducted by Spreckelsen et al [28]. The researchers found when students were able to participate in classroom-based math discussions, both the teachers and the students' understanding of complex mathematical concepts grew. The researchers investigated the different types of mathematical language used by teachers in a variety of different daily activities. The researchers found, "in settings with greater practitioners' breadth of math language, children display greater cardinality skills" (ibid). The research from both studies provides insight into how Maths Talk and mathematical discussions can have a positive impact on students' standardized test scores and their mathematical understanding. Susperreguy and Davis-Kean [29] also analysed the relationship between the amount of mathematical input children hear (i.e., math talk) and their Maths ability a year later. Through their research, Susperreguy and Davis-Kean [29] found children who were exposed to more conversations about math, such as math talks, tend to score higher on their standardized math tests a year later.

In addition to the positive correlations which exist between Maths Talk and higher standardised test scores, an interesting finding which is emerging from the research is that Maths Talk can help improve students' confidence and attitudes Maths. In the research described previously by Spreckelsen et al [28], the researchers found increases in both the practitioner's confidence in teaching math as well as the student's own confidence in Maths. Similarly, in research conducted by Hufferd-Ackles, Fuson, & Sherin [12], it emerged that both the teachers' and the students' confidence in partaking in mathematical discussions grew over the course of the research project.

Teacher as Facilitator Of Mathematical Discourse

As with most effective classroom practices, the pedagogical practices of the PMC are dynamic in nature and inherently interconnected. Intertwined within each of these practices is the crucial role of the teacher [19]. Dooley et al [7] highlight the important role the teacher plays in assisting children is using and articulating mathematical language in their 'descriptions, explanations and justifications'. Similarly, Hufferd – Ackles et al. [12] acknowledge the key role that teachers play in developing math-talk learning communities in classrooms.

Much discussion has been given to the role of the teacher in creating a Maths Talk community. In a study on educational discourse which was conducted over 15 years, Resnick et al [22] found teachers were successful at establishing norms and building a discourse culture involving risk-taking and the explicit modelling and practice of particular talk moves. Similarly, in research previously discussed by Hufferd – Ackles et al [12] the researchers found that the actions of the teachers in the study contributed significantly to the development of a classroom culture which embodied the key principles of Maths Talk. The foundational work of Barnes [1] also emphasized the teacher's central function in promoting effective classroom talk, suggesting that purposeful teacher intervention is essential for nurturing dialogue that deepens understanding during mathematics instruction.

As well as providing guidance and support, Bruner [4] highlights that the language used by the teacher in this new environment must express stance and invite counter – stance'. This suggests that the teacher's role extends beyond facilitation to creating an intellectual space where pupils are invited to adopt a critical lens, engage in debate, and become co-investigators of their mathematical thinking. The Primary Mathematics Toolkit identifies several core teaching practices which teachers can utilise to support the development of rich mathematical discourse in the classroom. These include the strategic use of 'talk moves' to engage pupils in dialogue for example revoicing, where the teacher restates a student's contribution to clarify or extend meaning as well as the use of effective questioning, the explicit connection of mathematical ideas and the incorporation of children's thinking to advance discussion, particularly through the identification and exploration of misconceptions [6].

Challenges

While the availability of such resources to support teachers is beneficial, one must consider the challenges which arise when trying to develop Maths Talk in classrooms. Perhaps more than any other school subject, mathematics has suffered from a 'talk and chalk' approach. This traditional approach to the teaching of mathematics is compounded by what Barnes [1] described as a "performance climate" in many classrooms where test scores are valued over pupils agency in the learning process. In performance-oriented classrooms, students are often discouraged from making mistakes or expressing uncertainty, which undermines the very ethos required for Maths Talk to flourish. This environment fosters fear of failure, reducing students' willingness to take intellectual risks, challenge ideas, or engage in open-ended discussion. What's more teachers working within such climates may feel pressured to cover content quickly and efficiently rather than investing time in rich discourse and exploratory talk.

To overcome this, Pound [1999] argues that there is a need for change in the traditional role of the teacher from transmitter of knowledge to facilitator of learning. Rogoff et al. [23] describe this evolving role of the teacher as that of a "knowledgeable other," whereby the teacher skilfully navigates between offering support and allowing autonomy in learning. It appears that what is required of teachers is to divest their role as fountain of all knowledge and transition towards a space where pupils are given equal opportunities to contribute to and shape classroom discourse. However, Lampart [13] writes, "The juxtaposition of responsibilities that make up the teacher's job lead to conceptual paradoxes with which the teacher must grapple"

Furthermore, NicMhuirí [16] analysis of mathematics lessons revealed that 'important opportunities for engaging in mathematical dialogue, including mathematical reasoning, may be overlooked'. This and similar work [7] point to a need to support teachers to reflect on their classroom dialogue and provide children with more opportunities to engage in mathematical thinking, along the lines described earlier. Specifically, it is claimed that there is an 'urgency' in promoting more interactive mathematical discourse in learning settings [10] Murata et al [15] also make the point that talk moves can be more or less effective in different classrooms, depending on how they are used to navigate the diversity of students' ideas in relation to mathematical goals.

Consideration must also be given to the possibility that some teachers may use talk moves differently. In fact, it has been noted in a study by O' Connors and Michaels [17] that some teachers appeared to be using the talk moves almost "robotically." It was also noted that while some of the

teachers in their study easily picked them up, other teachers, particularly those less experienced, seemed to find them difficult.

Math Talk Learning Community Framework

To support teachers in making the transition from a traditional approach to mathematics teaching, in which the teacher takes centre stage, to a discourse community, Hufferd-Ackles et al. [12] have produced developmental trajectories that address four aspects of mathematical discourse: questioning, explaining mathematical thinking, source of mathematical ideas and responsibility for learning. Developed from empirical data gathered from elementary classrooms, the trajectories show intermediary levels along which math-talk communities develop and allow teachers to address difficulties in developing mathematical talk and dilemmas as they move along. Rather than expecting an immediate shift to full dialogic engagement, the model recognises and maps out incremental stages of development, which are critical for both teachers and students. Importantly, the trajectories serve as both a reflective tool and a practical guide, helping educators to diagnose current levels of classroom talk, anticipate common challenges, and plan targeted strategies for growth. As such, they not only support the cultivation of mathematical reasoning and communication skills among students but also address the pedagogical dilemmas teachers often encounter—such as relinquishing control, encouraging equitable participation, and navigating diverse learner needs. The levels are summarised as follows:

Levels of the Math – Talk Learning Community: Action Trajectories for Teacher and Student

Level	Description
0	Teacher – directed classroom with brief answer responses from children
1	Teacher begins to pursue student mathematical thinking. Teacher plays central role in math-talk community
2	Teacher models and helps children build new roles. Some co teaching and co – learning begins as child – to – child talk increases
3	Teacher functions as co -teacher and co learner. Teacher monitors all that occurs, still full engaged. Teacher is ready to assist but now in a more peripheral and monitoring role

Recommendations and Future Considerations

A critical factor in advancing future research and implementation of effective Maths Talk is the establishment of sustainable support systems within schools that promote ongoing teacher development. Central to this is the creation of structured mentoring and collaborative professional learning communities, where teachers are provided with opportunities to observe each other's practice, engage in reflective dialogue, pose challenging questions, and collectively enhance their pedagogical strategies [30]. Hufferd-Ackles et al. [12] argue that for productive mathematical

discourse to flourish, educators must be supported in making significant shifts in instructional approach—moving from teacher-centred to student-centred discourse communities.

In addition, it has been argued that future research must examine various ways to help teachers make the changes necessary for productive Maths Talk to take place in their classrooms. Supports that could be widely available are curricular supports embedded within a curriculum, materials to support teacher discussion and reflection, videos of classrooms illustrating the framework in action, and web-based teacher assistance programs that could provide answers to teachers' questions.

Equally important is the cultivation of a classroom culture grounded in mutual respect, intellectual risk-taking, and inclusive participation. Mathematical learning thrives in environments where all students are viewed as active constructors of knowledge, and where dialogue—both between students and between students and teachers—drives conceptual development [14]. In inclusive settings, the psychological safety of students is paramount; learners must feel empowered to articulate, challenge, and refine their mathematical ideas without fear of judgement or exclusion.

Ronda [24] proposes the 'Four Freedoms' as essential conditions for inclusive mathematical dialogue: the freedom to make mistakes, to ask questions, to think independently, and to choose one's own methods. These principles underscore the value of agency and voice in the learning process. Complementing this view, Zack and Graves [33] emphasise the importance of fostering a classroom ethos where students are encouraged to explain and justify their reasoning

There is also a notable absence on the impact of the home mathematics environment on Maths Talk in the recent educational research. Eason et al [11] argue that parents' attitudes and expectations regarding mathematics, their time, resources and language input are all related to children's mathematical abilities. This is of particular importance for children from low-income families as they are provided with fewer opportunities at home and are less likely to have acquainted themselves with mathematical language [21].

A final consideration for future research in this area is gender – different learning and the possible impact on the development of Maths Talk. The results of such studies in gender specific schools in the future would be interesting and may yield some interesting comparable results with the above studies. Chambers [5] also makes reference to the need for consideration for pupils preferred learning styles in future research in the area. Chambers [5] argues that for discourse-focused pedagogical strategies to be truly inclusive and effective, the associated resources and activities must be designed in ways that are accessible to all learners. This includes ensuring that students with varying cognitive strengths, communicative abilities, and learning preferences are equally able to engage in and benefit from these tasks. Chambers emphasises that if Maths Talk is to foster genuine participation and equitable learning outcomes, the materials and teaching approaches used must not only encourage dialogue but also support differentiated access to mathematical thinking and communication.

Conclusions

This paper has explored the complexities and possibilities of *Maths Talk* as a pedagogical practice within the Primary Mathematics Curriculum. Drawing on sociocultural theories and empirical findings, it has been argued that purposeful mathematical talk not only enhances reasoning and sense-making but also fosters a classroom culture rooted in collaboration and inclusion. While the availability of tools to support teachers is promising, significant tensions remain. These include the persistence of performance-driven classroom norms, time constraints, and the challenge of navigating competing discourses around correctness and efficiency.

The *Math-Talk Learning Community Framework* offers a valuable lens through which to support and scaffold teachers in developing purposeful Maths Talk. However, moving towards more dialogic classrooms demands more than tools; it requires a reconceptualisation of the teacher's role from knowledge transmitter to facilitator. This transition can be challenging, as teachers negotiate the paradoxes inherent in supporting student agency while ensuring mathematical integrity. Ultimately, for *Maths Talk* to be fully realised as an essential and not idealistic element of mathematics education, sustained professional support and a shared commitment to dialogic teaching must be prioritised.

REFERENCES

[1] Barnes, D. (1976). *From communication to curriculum.* Penguin.

[2] Bakhtin, M. M. (1981). *The dialogic imagination: Four essays* (M. Holquist, Ed.; C. Emerson & M. Holquist, Trans.). University of Texas Press. (Original work published 1935)

[3] Bruner, J. (1960). *The process of education.* Harvard University Press.

[4] Bruner, J. (1986). *Actual minds, possible worlds.* Harvard University Press.

[5] Chambers, P. (2008). *Teaching mathematics.* London: Sage.

[6] Chapin, S. H., O'Connor, C., & Anderson, N. C. (2009). *Classroom Discussions: Using math talk to help students learn, Grades K-6.* Sausalito: Math Solutions.

[7] Dooley, T. (2011). Re-engaging pupils with mathematics: Teachers' learning and teaching approaches. In T. Dooley, D. Corcoran, & M. Ryan (Eds.), *Proceedings of the Fourth National Conference on Research in Mathematics Education* (pp. 186–195). St. Patrick's College, Drumcondra.

[8] Dooley, T., Dunphy, E., Shiel, G., Butler, D., Corcoran, D., Farrell, E., & Travers, J. (2014). *Mathematics in early childhood and primary education (3–8 years): Teaching and learning.* NCCA.

[9] Dunphy, E., Dooley, T., & Shiel, G. (2014). Mathematics in early childhood and primary education: A review of research and policy. In NCCA (Ed.), *Mathematics in early childhood and primary education (3–8 years): Teaching and learning* (pp. 21–66). NCCA.

[10] Dunphy, E., Dooley, T., & Shiel, G. (2016). Mathematics education in early childhood and primary education. *Irish Educational Studies, 35*(1), 49–66. https://doi.org/10.1080/03323315.2016.1146156

[11] Eason, S. H., Goldberg, L. R., Young, K. M., & Vanderwood, M. L. (2000). Math instruction in high-stakes environments. *Journal of Instructional Psychology, 27*(4), 205–212.

[12] Hufferd-Ackles, K., Fuson, K. C., & Sherin, M. G. (2004). Describing levels and components of a math-talk learning community. *Journal for Research in Mathematics Education, 35*(2), 81–116. https://doi.org/10.2307/30034933

[13] Lampart, A. (1985). The moral dilemmas of teaching. In D. Hansen (Ed.), *The call to teach* (pp. 178–183). Teachers College Press.

[14] Mercer, N., & Fisher, E. (1992). How do teachers help children to learn? An analysis of teachers' interventions in computer-based activities. *Learning and Instruction, 2*(4), 339–355. https://doi.org/10.1016/0959-4752(92)90022-e

[15] Murata, A., Siker, J., Kang, B., Baldinger, E. M., Kim, H.-J., Scott, M., & Lanouette, K. (2017). Math talk and student strategy trajectories: The case of two first-grade classrooms. *Cognition and Instruction, 35*(4), 290–316. https://doi.org/10.1080/07370008.2017.1362408

[16] NicMhuirí, S. (2011). Teaching mathematics: Tensions between traditional and constructivist approaches. In S. Close, T. Dooley, & D. Corcoran (Eds.), *Proceedings of the Second National Conference on Research in Mathematics Education (MEI 2)* (pp. 57–65). St. Patrick's College, Dublin.

[17] O'Connor, M. C., & Michaels, S. (2007). When is dialogue 'dialogic'? *Human Development, 50*(5), 275–285.

[18] Piaget, J. (1952). *The origins of intelligence in children* (M. Cook, Trans.). International Universities Press. (Original work published 1936)

[19] Pound, L. (1999). *Supporting mathematical development in the early years.* Open University Press.

[20] Purpura, D. J., & Reid, E. E. (2016). Mathematics and language: Individual and group differences in mathematical language skills in young children. *Early Childhood Research Quarterly, 36*, 259–268. https://doi.org/10.1016/j.ecresq.2015.12.020

[21] Purpura, D. J., Hume, L. E., Sims, D. M., & Lonigan, C. J. (2019). Early mathematics and reading development: Mathematical language as a mediating mechanism. *Journal of Experimental Child Psychology, 180*, 39–54.

[22] Resnick, L. B., Michaels, S., & O'Connor, M. C. (2010). How (well-structured) talk builds the mind. In D. D. Preiss & R. J. Sternberg (Eds.), *Innovations in educational psychology: Perspectives on learning, teaching, and human development* (pp. 163–194). Springer Publishing Company.

[23] Rogoff, B., Mistry, J., Göncü, A., & Mosier, C. (1996). Guided participation in cultural activity by toddlers and caregivers. *Monographs of the Society for Research in Child Development, 61*(1–2), i–174. https://doi.org/10.2307/1166129

[24] Ronda, E. (2012). Creating a climate for learning mathematics in the early years. *Mathematics Education Research Journal, 24*(2), 205–227.

[25] Saylor, M., & Walton, D. (2018). The relationship between classroom discourse and student achievement. *Mathematics Education Research Journal, 30*(3), 307–327.

[26] Sfard, A. (2007). When the rules of discourse change, but nobody tells you: Making sense of mathematics learning from a commognitive standpoint. *Journal of the Learning Sciences, 16*(4), 565–613. https://doi.org/10.1080/10508400701525253

[27] Shotter, J., & Billig, M. (1998). A psychological poetry of the living moment: Bakhtin and Vygotsky. In M. M. Bell & M. Gardiner (Eds.), *Bakhtin and the human sciences: No last words* (pp. 145–175). SAGE Publications.

[28] Spreckelsen, T. F., Reiss, K., & Heinze, A. (2019). Developing mathematical discourse in classrooms: A review of teacher support practices. *ZDM–Mathematics Education, 51*, 209–222.

[29] Susperreguy, M. I. (2016). Chapter 4 - Math Talk Between Children and Mothers and Its Connection to Math-Related Practices in the Home Setting. *ScienceDirect.* https://www.sciencedirect.com/science/article/abs/pii/B9780128036242000047?via%3Dihub

[30] Sztajn, P., Wilson, P. H., Edgington, C., & Myers, M. (2020). *Mathematizing children's literature: Sparking connections, joy, and wonder through read-alouds and discussion*. National Council of Teachers of Mathematics.

[31] Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Harvard University Press.

[32] Wagganer, E. L. (2015). Creating Math Talk Communities. *Teaching Children Mathematics, 22*(4), 248–254. Available at: ERIC - Education Resources Information Center

[33] Woods, D. M. (2022). Building a math-talk learning community through number talks. *The Journal of Mathematical Behavior, 67*, 100995. https://doi.org/10.1016/j.jmathb.2022.100995