CULTURAL VARIATIONS IN THE QUALITY AND QUANTITY OF STUDENTS' OPPORTUNITIES TO PARTICIPATE IN CLASSROOM DISCOURSE

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Opportunities for students to share their thinking in mathematics lessons has been a focus of mathematics education research for many years. There is now substantial evidence of the benefits to students' learning from participating in discussions around mathematics as well as a growing body of research focusing on what teachers can do to support students in sharing their thinking in meaningful ways. The evidence around the cultural and normative influences on students' opportunities to participate is more limited. In this paper, results from an international video study of mathematics teaching involving eight countries are shared, focusing on what we can learn about variations in students' opportunities to participate in classroom discourse.

INTRODUCTION

The importance of opportunities for students to share their thinking in mathematics lessons for their learning is now widely recognised. There is a wealth of research examining the associations between participation and learning, the different natures of this participation, as well as the teacher moves that can initiate and sustain different types of participation. Classroom norms around participation and interactions also influence both the quantity and quality of student participation. Yet cultural norms also influence these classroom norms and there is limited research focused on the cultural variations in student participation. In this paper, results from an international video study of mathematics teaching involving eight countries are shared, focusing on the extent to which students share their thinking in these eight contexts, alongside the evidence available about the nature of this shared thinking. International studies of mathematics teaching have both illustrated what we can learn from other country contexts, but also the challenges of supporting teachers to develop their practice whilst taking the distinctive cultural setting into account.

BACKGROUND AND THEORETICAL APPROACH

Classroom discussion and mathematical discourse have been a growing focus of mathematics education research for many years. More recently, there has been a growing interest in large-scale quantitative studies focusing on both the nature and the quality of this discourse (Howe et al., 2019; Lim et al., 2019) that builds on the abundance of smaller scale research conceptualising classroom discussions and the roles of teachers and students within these (Erath et al., 2021; Ingram, 2021;

2023. In M. Ayalon, B. Koichu, R. Leikin, L. Rubel., & M. Tabach (Eds.). *Proceedings of the 46th Conference of the International Group for the Psychology of Mathematics Education*, Vol. X, pp. XX-YY). PME.

O'Connor & Michaels, 1996; Stein et al., 2015). There is now substantial evidence for the benefits of classroom discussions and interactions for supporting mathematics learning. For example, Resnick and colleague's (2018) recent review of studies focused on classroom discourse identifies four effects of classroom discourse that supports students' learning: increased learning, longer enduring learning gains, better learning of topics not taught using discussions, and stronger reasoning skills.

Mathematical discourse is a broad term that includes "ways of talking, acting, interacting, thinking, believing, reading, writing but also mathematical values, beliefs, and points of view" (Moschkovich, 2003, p. 326) and classroom discussions and interactions make visible the mathematical discourses that are used in classrooms, but can also "ignite and coordinate student thinking" (Chen et al., 2020, p. 644). It is through these discourses that students learn what it means to learn maths and what it means to do mathematics. In light of this, recent research has argued for the need for opportunities for students to discuss and explain mathematics and the necessity of planning and designing these opportunities (Erath et al., 2021; Stein et al., 2008). Other research has identified the importance of teachers responding to and building upon students' ideas in mathematics discussions (Lim et al., 2019).

Within mathematics education specifically, the majority of studies of classroom discourse and interaction have been restricted to a single country context. However international studies of mathematics teaching have revealed that there are distinctive cultural variations in both the frequency and the nature of mathematics teaching and learning practices. For example, the findings from the Programme for International Student Assessment (PISA) in 2012, the most recent cycle where mathematics was the focus, illustrated considerable variation across countries in students' perspectives on how often teachers asked students to present their thinking (OECD, 2013). Similarly the Learner's Perspective Study showed revealed variations in the extent to which students had opportunities to speak mathematics in lessons which Xu and Clarke (2019) argue reflects the inspirations and cultural values attached to particular types of student participation.

METHODS

The analysis described here is part of a larger study that investigated the teaching and learning of quadratic equations across eight countries and jurisdictions, the TALIS Video Study that is part of the Organisation for Economic Co-operation and Development's (OECD) Global Teaching InSights programme (OECD, 2020). This study collected two videos from between 50 and 110 teachers in each context as well as the lesson materials, student and teacher questionnaires, and student assessments. The videos were then rated by trained raters against higher-inference component rating scales and lower-inference indicator rating scales. The study used a two-stage random sampling design however the actual sampling process in each of the country contexts varied meaning that the teaching captured in the videos can only be

considered representative of the teaching of quadratic equations in five of the eight contexts. The sample in Germany was a convenience sample.

This paper focuses on the video component analysis across the different country contexts that include a measure of students' contributions within classroom interactions rather than the more usual focus on teacher actions that initiate these contributions. The three video component ratings of interest from the study are the *Nature of discourse* which measured the extent to which the classroom interaction was teacher-directed and the level of detail included in student contributions, *Eliciting student thinking* which measured how much student thinking was present and the extent to which student contributions focused on answers and procedures or ideas and concepts, and *Aligning instruction to present student thinking* which measured how frequently teachers either used student contributions or how frequently they provided support when a student made an error or struggled mathematically. Full details of the video component scales and the coding process for the broader study, including the inter-rater reliability measures, can be found in the international reports (Bell, 2020; Bell et al., 2021; OECD, 2021).

The videos were scored against each of the video component measures on a scale of 1 to 4 every 16 minutes (a lesson segment) by two trained raters. Average ratings across both raters, then lessons and then teachers were included in the international report. In this paper the focus is at the lesson level and the maximum ratings within a lesson for each of the three video component ratings, as well as the coincidence of the three ratings at the lesson segment level. Arguably, for each of these teaching measures we would not necessarily expect to see high levels of detailed classroom interactions for the full duration of a lesson as lessons often include opportunities for teachers to introduce or explain ideas, and opportunities for students to work independently or in small groups rather than as a whole class. The use of the maximum rating in a lesson enables an examination of cultural variations in the extent to which teachers use discussions and whole class interactions as part of their pedagogic repertoire as well as some aspects of the nature of these interactions rather than as an indicator of a particular teaching style.

The analysis below examines the lessons that included an average rating across the two raters of 2.5 or more on the *Nature of Discourse* at some point during the lesson, meaning that there were points in the lesson where the discourse was sometimes or rarely teacher-directed and students' discourse was sometimes or frequently characterised by detailed contributions. Similarly, for *Aligning instruction to present student thinking* the focus was on lessons that included an average rating of 3.5 or more meaning that the teacher frequently used students' contributions or if students made errors or struggled mathematically, the teacher frequently provided cues or hints to support student understanding. For *Eliciting student thinking* a distinction is made between a maximum rating of 2.5 and above and 3.5 and above. These ratings mean that there was a moderate amount or a lot of student thinking present and that

the questions, prompts and tasks resulted in detailed student contributions that concerned answers, procedures and the steps necessary for solving a problem, or for the highest possible rating (3.5 or above) ideas or concepts as defined in the conceptualisation of teaching used in the study (Bell et al., 2021).

At the lesson segment level, i.e., one of the 16-minute episodes that were rated, the analysis focuses on those lessons segments rated as 2.5 or above for *Nature of Discourse* and then examined the extent to which these lesson segments also included a highest ratings (3.5 or more) for *Eliciting student thinking* or *Aligning instruction to present student thinking*. This focuses the analysis on those lesson segments where students were making detailed contributions and the potential nature of these contributions alongside how teachers uses these contributions in their own teaching. Although the data for all the participating contexts is reported, the discussion focuses on four contexts that illustrate the differences between contexts: Colombia, England, Germany and Shanghai.

FINDINGS

Almost all lessons in England and Germany (90% and 95% respectively) included a lesson segment with a maximum rating of 2.5 or more for the *Nature of Discourse*. In contrast only around half of the lessons in Shanghai and Colombia (54% and 45% respectively) included a lesson segment with this rating. Similarly in England and Germany around three quarters (73% and 79%) of lessons included a lesson segment with a maximum rating of 3.5 or more for *Aligning instruction to present student thinking*, whereas in Shanghai (28%) and Colombia (24%) the proportion of lessons is closer to one quarter. The proportions for all countries are given in Table 1. This reveals cultural variations both in the extent to which students contribute to classroom discourse where in England and Germany students making detailed contributions is a common practice and appears to be part of the classroom norms. In contrast, in many other contexts such as Shanghai and Colombia there is more variation between teachers in terms of the level of detail of student contributions within lessons. Similarly, in England and Germany it was typical of lessons to include segments where teachers responded to their student contributions in some way, either by building on their ideas or by supporting them when they encountered difficulties. In other contexts, such as Shanghai and Colombia, this was observed more rarely.

Context	Number of lessons	Nature of Discourse (%)	Aligning instruction to present student thinking (%)	Eliciting student thinking (%)
Chile	196	65	42	15
Colombia	166	45	24	17
England	167	90	73	31

Germany	100	95	79	48
Japan	177	80	61	40
Madrid	169	83	38	20
Mexico	206	68	39	23
Shanghai	170	54	28	61

Table 1: Proportion of lessons including a segment with a higher rating for *Nature of Discourse* (2.5 or more) or *Aligning instruction to present student thinking* (3.5 or more) or *Eliciting student thinking* (3.5 or more)

The analysis that focuses on the nature of these student contributions using the highest rating for *Eliciting student thinking* reveals a different picture, irrespective of the detail of a student contribution. In Shanghai 61% of lessons included a lesson segment where a student contribution focused on an idea or a concept at least briefly. This was the only context where this happened in the majority of lessons. In all other contexts the majority of lessons did not include a student contribution focused on ideas or concepts, with student contributions focused instead on ideas, procedures or the steps necessary for solving a problem.

At the lesson segment level, within lesson segments rated as sometimes or frequently including student detailed contributions (2.5 or above for *Nature of Discourse*) 49% of these segments in Shanghai also included the highest rating for *Eliciting student thinking*, meaning they included a student contribution focused on an idea or concept. While 29% in Japan, 21% in England and 18% in Colombia of these segments included a student contribution focused on an idea or concept. The proportion of lessons for all contexts are reported in Table 2.

Context	Rating of 3.5 or more	
	Eliciting student thinking (%)	Aligning instruction to present student thinking (%)
Chile	8	27
Colombia	18	25
England	21	62
Germany	28	46
Japan	29	49
Madrid	18	30
Mexico	22	30

Shanghai	49	16

Table 2: Proportion of lesson segments rated as 2.5 or above for Nature of Discourse also including the highest rating (3.5 or above) for *Eliciting Student Thinking* or a high rating (2.5 or above) for *Aligning instruction to present student thinking*.

DISCUSSION

These findings illustrate both within and between country context variations in participation in classroom discourse in interaction. Within England and Germany there is little variation within the context as students contributing in a detailed way occurred in almost all lessons at some point. In both these contexts this may be a feature of lessons with higher achieving students as the curriculum in these two contexts restricts lower attaining students' access to some of the content that was the focus of the TALIS Video Study, and hence the teaching captured may not be representative of mathematics teaching more generally.

In contrast, in both Shanghai and Columbia there is variation between teachers in that only around half of the lessons included detailed student contributions. However, when students contribute in Shanghai, the nature of these contributions is more likely to include reference to an idea or concept than in the other contexts. In all contexts the majority of student contributions focused on answers, procedures or the steps needed to solve a problem, but only in some classrooms did students also engage with ideas and concepts.

These results reflect much of the recent research in the West that has focused on providing students opportunities to participate in mathematical discourses and on responsive teaching. Yet in Shanghai the quality and nature of student participation is also something that teachers appear to consider, enabling students to go beyond the routine reporting and describing of processes to discussing ideas and concepts, something that is widely advocated for in the literature (Chen et al., 2020; Erath et al., 2021; Stein et al., 2008).

This paper has pointed to cultural variations in both the quantity and quality of student participation in mathematics lessons. However the data is limited by the focus on just one mathematical topic (quadratic equations) and to students at a stage of education where this topic is taught in each contexts (aged between 13 and 17 years old). The analysis is also limited by the specific measures used in TALIS Video Study, which only capture a narrow range of aspects of student participation. They also will not capture sequential aspects of student contributions and also do not distinguish between teachers building and using student ideas and teachers supporting students when they encounter a difficulty. It would be interesting to see if these variations are also apparent in other topics and at other education stages.

The focus in this paper has been on variations and differences, but it is important to note the similarities. The average ratings in the international report from the study

point to relatively few opportunities students have to discuss mathematics in lessons, either through detailed contributions to whole class interactions, or through group or pair work. Yet students need something to talk about. The inclusion of opportunities to contribute, in detailed ways or in relation to ideas and concepts as well as procedures and answers, is part of the majority of lessons in all the contexts considered here. Opportunities to contribute are a tool widely used by most teachers, but further research is needed to explore whether these variations in opportunities have different influences on students' learning in different contexts.

References

Bell, C. A. (2020). Rating teaching components and indicators of video observations. In *Global Teaching InSights: Technical Report: Vol. Section II*. OECD Publishing.

Bell, C. A., Klieme, E., & Praetorius, A.-K. (2021). Conceptualising teaching quality into six domains for the Study. In OECD (Ed.), *Global Teaching InSights: Technical Report*. OECD.

Chen, G., Chan, C. K. K., Chan, K. K. H., Clarke, S. N., & Resnick, L. B. (2020). Efficacy of video-based teacher professional development for increasing classroom discourse and student learning. *Journal of the Learning Sciences*, *29*(4–5), 642–680. https://doi.org/10.1080/10508406.2020.1783269

Erath, K., Ingram, J., Moschkovich, J., & Prediger, S. (2021). Designing and enacting instruction that enhances language for mathematics learning: A review of the state of development and research. *ZDM - Mathematics Education*, *53*(2), 245–262. https://doi.org/10.1007/s11858-020-01213-2

Howe, C., Hennessy, S., Mercer, N., Vrikki, M., & Wheatley, L. (2019). Teacher–Student Dialogue During Classroom Teaching: Does It Really Impact on Student Outcomes? *Journal of the Learning Sciences*, *0*(0), 1–51. https://doi.org/10.1080/10508406.2019.1573730

Ingram, J. (2021). *Patterns in Mathematics Classroom Interactions: A conversation analytic approach*. Oxford University Press. https://doi.org/10.1093/oso/9780198869313.001.0001

Lim, W., Lee, J. E., Tyson, K., Kim, H. J., & Kim, J. (2019). An Integral Part of Facilitating Mathematical Discussions: Follow-up Questioning. *International Journal of Science and Mathematics Education*, *18*(2), 377–398. https://doi.org/10.1007/s10763-019-09966-3

Moschkovich, J. N. (2003). What counts as mathematical discourse? In N. A. Pateman, B. J. Dougherty, & Zillox (Eds.), Proceedings of the 2003 joint meeting of Psychology of Mathematics Education and Psychology of Mathematics Education-North American Chapter (Vol. 3, pp. 325–331). University of Hawaii.

O'Connor, C., & Michaels, S. (1996). Shifting participant frameworks: Orchestrating thinking practices in group discussion. In D. Hicks (Ed.), *Discourse, learning, and schooling* (pp. 63–103). Cambridge University Press. https://doi.org/10.1017/cbo9780511720390.003

OECD. (2013). *PISA 2012 Results: Ready to learn (Volume III): Students' engagement, drive and self-beliefs*. https://read.oecd-ilibrary.org/education/pisa-2012-results-ready-to-learn-volume-iii/the-role-of-teachers-and-schools-in-shaping-students-engagement-drive-and-self-beliefs_9789264201170-9-en

OECD. (2020). Global Teaching InSights: A video study of teaching. In *Global Teaching InSights: A video study of teaching* (pp. 246–266). OECD. https://doi.org/10.1787/20d6f36b-en

OECD. (2021). *Global Teaching InSights: Technical Report*. OECD. https://www.oecd.org/education/school/global-teaching-insights-technical-documents.htm

Resnick, L. B., Asterhan, C. S. C., & Clarke, S. N. (2018). Next generation research in dialogic learning. In G. E. Hall, L. F. Quinn, & D. M. Gollnick (Eds.), *The Wiley Handbook of Teaching and Learning* (pp. 323–338). Wiley-Blackwell.

Stein, M. K., Engle, R. A., Smith, M. S., & Hughes, E. K. (2008). Orchestrating Productive Mathematical Discussions: Five Practices for Helping Teachers Move Beyond Show and Tell. *Mathematical Thinking and Learning*, *10*(4), 313–340. https://doi.org/10.1080/10986060802229675

Stein, M. K., Engle, R. A., Smith, M. S., & Hughes, E. K. (2015). Orchestrating Productive Mathematical Discussions: Helping Teachers Learn to Better Incorporate Student Thinking. In L. Resnick, C. Asterhan, & S. Clarke (Eds.), *Socializing Intelligence Through Academic Talk and Dialogue* (pp. 375–388). American Educational Research Association. https://doi.org/10.3102/978-0-935302-43-1_29

Xu, L., & Clarke, D. (2019). Speaking or not speaking as a cultural practice: Analysis of mathematics classroom discourse in Shanghai, Seoul, and Melbourne. *Educational Studies in Mathematics*, 127–146. https://doi.org/10.1007/s10649-019-09901-x