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USING GALLERY WALKS FOR COMPARE AND CONNECT: DEVELOPING ADAPTIVE EXPERTISE OF MATHEMATICS LANGUAGE ROUTINES

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We examined teachers' development of adaptive expertise of mathematics language routines (MLRs) as they engaged in Studio Day professional learning focused on the MLR Compare and Connect. We collected video data from pre- and post-Studio Day meetings, as well as debriefs and their lesson enactments. We analyzed the data using three dimensions of adaptive expertise: flexibility, deeper level of understanding, and deliberate practice. We share a case study of a teacher exhibiting dimensions of adaptive expertise during the Studio Day Cycle through the use of a gallery walk. The teacher's enactment of the MLR Compare and Connect provides an image of a teacher's adaptive expertise of this MLR and helps us understand these MLRs and how teachers use and make sense of them in their instruction.

Keywords: Professional development; equity, inclusion, and diversity

This paper focuses on a professional learning experience for secondary mathematics teachers that used Studio Days model of professional learning (Von Esch & Kavanagh, 2018), which is a modified version of Japanese Lesson Study. Our Studio Day experience for teachers was focused on language and mathematics simultaneously through the use of mathematics language routines (MLRs; Zwiers et al., 2017), a unique experience for most mathematics teachers, as few mathematics teachers have had professional learning experiences that bridge both multilingual learners and mathematics teaching (Ballantyne et al., 2008). MLRs are scaffolded routines intended to lead to students' independent participation in the mathematics classroom through supporting sense-making, optimizing output, cultivating conversation, and maximizing linguistic and cognitive meta-awareness (Zwiers et al., 2017). In this Studio Day Cycle, teachers learned about the MLR Compare and Connect, which engages students in comparing and contrasting different mathematical approaches through examining different mathematical representations, approaches, examples, or language (Zwiers et al., 2017). Students are meant to develop meta-cognitive and meta-linguistic through their conversations with peers (Zwiers et al., 2017). Teachers need more than a cursory understanding of these MLRs to help their students to use and make sense of these routines in their classrooms (i.e., more than reading directions of how to use them off a page). Additionally, as a field, we need to understand how teachers use and make sense of these routines. Therefore, we saw Studio Day professional learning experiences as a space for teachers to develop adaptive expertise with MLRs. We define adaptive expertise as the ability to implement MLRs with the flexibility to navigate a localized context without sacrificing ambition or complexity (Hatano & Inagaki, 1984). Our research question was: How did a teacher make sense of the MLR Compare and Connect during a Studio Day Cycle in ways that demonstrated their adaptive expertise?

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Adaptive Expertise

Our theoretical framework uses the construct adaptive expertise (Hatano & Inagaki, 1984), as defined above. Adaptive experts differed from routine experts because they were able (a) to adapt to a desired outcome; (b) to demonstrate the usefulness of their skill; and (c) to find value in their work from their group members. Schwartz et al. (2005) explained the importance of being able to move away from efficiency. For example, it takes time and effort to move from learning a single routine to learning multiple routines and being flexible with them. Von Esch and Kavanagh (2018) also developed on Hatano and Inagaki's concept of expertise and noted that adaptive expertise is being able to draw on and retrieve relevant existing knowledge. For example, adaptive experts are able to flexibly use knowledge that they have developed around a framework they have developed.

Teachers who possess adaptive expertise are use their knowledge of their students as they adapt their practices, curriculum, and instruction (Beltramo, 2017), scaffolding students' mathematical development through the use of effective instruction and appropriate assessment tools (Heinze et al., 2009). In this study, we were particularly interested in teachers' development of adaptive expertise as related to MLRs, so as to better attend to multilingual learners. We operationalize our definition of adaptive expertise, drawing from Yoon et al. (2019), who identified three dimensions of adaptive expertise—flexibility: exhibits an awareness of students, particularly multilingual learners and context, as related to MLRs; deeper understanding: brings in variations related to the MLRs and considers affordances and constraints of the MLRs; and deliberate practice: demonstrates motivation, focus, and repeated effort to monitor their practice and devises and subsequently attempts improved implementation. These categories of adaptive expertise will be used for understanding how the secondary teachers demonstrated adaptive expertise of the Compare and Connect MLR within their participation during a Studio Day Cycle.

Method

Our study was situated in a school district on the West Coast that included a substantial number of multilingual learners. This paper focuses on the second of three Studio Day Cycles during the 2023-24 school year.

Context: Studio Days Enactment of Multilingual Learner Principles and MLRs

Each Studio Day Cycle involved three professional development meetings and targeted a single MLR, with this cycle attending to the MLR Compare and Connect, described in the introduction. During the pre-Studio Day, teachers learned about the MLR and prepared to implement a lesson that included this MLR. Teachers then enacted this lesson at their school during the Studio Day, with teachers observing each other's implementation. During the final day of the cycle, the post-Studio Day, teachers examined and analyzed student work and video clips from the implementation, shared challenges and successes, and considered implications for their future practice.

Participants

Four junior high school teachers from the three junior high schools in the district participated in the study. This paper is a descriptive case study (Merriam, 1998) of one of these teachers, Ms. Severn.

Data Collection and Data Analysis

The larger project collected multiple sources of data; because of the brevity of this report, we focused on videotaped pre-, post-, and Studio Day meetings with teachers, as well as videotaped classroom enactments. We transcribed these videos using Otter.ai and then cleaned the transcriptions. We examined the transcripts, and first coded for instances when there were instances of MLRs occurring within the data. Next, we coded these MLR instances for adaptive expertise related to the MLR within each aspect of the Studio Day Cycle transcripts. We used a priori codes of Yoon et al.'s (2019) three dimensions of adaptive expertise: flexibility, deeper understanding, and deliberate practice to code our multiple data sources. We then examined each occurrence within a single Studio Day component (i.e., only pre-Studio Day), as well as examined each adaptive expertise dimension (i.e., only flexibility) to make sense of how participants demonstrated adaptive expertise of the Compare and Connect MLR within their participation during a Studio Day Cycle. We looked for themes within the Studio Day components and the adaptive expertise dimensions and share these themes within our findings.

Findings

We found that one teacher, Ms. Severn, used a gallery walk (e.g., sharing student work) to make sense of and enact the Compare and Connect MLR with their students, thereby making the MLR their own and exhibiting their adaptive expertise of the MLR. We share key dimensions of their adaptive expertise from aspects of the Studio Day Cycle to illustrate the teachers' process for this work.

Pre-Studio Day

Part of the initial work during the pre-Studio Day is to provide teachers an overview of the MLR. During this initial overview, the first author shared that there were multiple ways for teachers to "Compare" work during the Compare and Connect MLR. The author noted, "You could do a gallery walk and just have students put up work." A few minutes later, Ms. Severn asked, "How would a gallery walk work in our classroom with filming students?" Because this is a research study, there are considerations regarding moving non-consented students out of sight during lessons. However, we were very mindful of keeping lessons flowing as normally as possible and let Ms. Severn know this. We highlight that Ms. Severn was already considering how to enact Compare and Connect before she had experienced the routine—simply after a brief overview of the routine. This is the beginnings of Ms. Severn's deeper level of understanding, as she considered contexts in which to apply the MLR within her own classroom. Ms. Severn was using knowledge of her own students to begin to make the lesson her own (Beltramo, 2017).

Studio Day – Ms. Severn's Gallery Walk

Ms. Severn taught the first lesson during the Studio Day. She provided an overview of her lesson during the pre-brief, then taught her lesson, and then had a debrief of her lesson.

Pre-brief of Ms. Severn's enactment. The group began the day with an overview of Ms. Severn's lesson. Ms. Severn explained that the lesson would be focused on a proportional relationship, with each group solving with a specific representation. She explained: "So, I'll assign them to use an equation and a unit rate, a table, or a graph…Then we'll have them look at each other's representations and compare how they solved the problem against each representation." This task considered how Ms. Severn brought the MLR into her own classroom practice, within a specific mathematics task, illustrating a deeper level of understanding. Further, Ms. Severn shared that the MLR was meant to get the students talking to each other about mathematics, because the class was "really hesitant to talk at all." Enacting the MLR as she did

employed Ms. Severn's flexibility, or her awareness of her students, particularly her multilingual learners, as she worked to adapt to their needs, particularly getting them to talk about the mathematics in her class.

Ms. Severn's enactment of the gallery walk. Ms. Severn introduced the task and reminded them of the work they had already done related to the content:

> We've talked about tables this unit. We've talked about equations this unit. We've talked about graphs this unit. Each of your table groups is going to get randomly assigned one of those representations and then you're only going to be able to solve the problem with that representation.

She then told the students that "each group needs a poster." Students then knew what was required of them within the task but notifying students of the work they would be doing also illustrated, as noted above, how she had made the MLR her own, highlighting her deeper level of understanding of the MLR. The structure of the MLR as enacted went beyond the first author suggesting, "You could do a gallery walk."

Approximately 22 minutes into the class, Ms. Severn further explained the class' work to complete within the MLR, noting,

> We're doing to do what's called a 'gallery walk'….I'm going to give you this graphic organizer here, and it says 'ratio,' 'table of values,' 'graph,' and 'equation.'…And you are going to have four minutes to walk around the classroom and look at how other people solved this problem and write in the box describing how groups solved the problem.

Ms. Severn, in providing students with a graphic organizer, attended to students' linguistic and mathematical needs during the Compare and Connect MLR, highlighting her flexibility. A graphic organizer, such as this, provided a scaffold for multilingual learners, which allowed access to the content for multilingual learners (Echevarria et al., 2006). Further, Ms. Severn made the gallery walk her own, providing guidelines to students, moving from the broad strokes provided in the pre-Studio Day to fine-tuned details needed for enactment with students, exemplifying a deeper level of understanding. She further provided students with sentence frames and direction for how to engage in their discussions in pairs, for example, "If you're the partner that's sitting closer to the back wall…you are the partner that's going to speak first." These language supports provided ways for multilingual learners to engage in the discussions that she had wanted to support and had noted in the pre-brief, marking, again, her flexibility, particularly related to her multilingual learners.

Discussion

We found that a teacher made sense of the MLR Compare and Connect during a Studio Day Cycle in ways that demonstrated their adaptive expertise through the use of a gallery walk, exhibiting both her deeper level of understanding and her flexibility (Yoon et al., 2019). Ms. Severn was able to use this MLR to engage students in mathematical conversations around proportional reasoning through the gallery walk and more specifically through her graphic organizer—supporting students both mathematically and linguistically (Zwiers et al., 2017). Her flexibility illuminated her attention to multilingual learners. Ms. Severn's enactment of the MLR Compare and Connect provides the field an image of a teacher's adaptive expertise of this MLR. Such an imagine helps us understand these MLRs and how teachers use and make sense of them

in their instruction. Future research can then examine how students, particularly multilingual learners, use and make sense of these MLRs in their learning.

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References

Ballantyne, K. G., Sanderman, A. R., & Levy, J. (2008). *Educating English Language Learners: Building Teacher Capacity. Roundtable Report.* National Clearinghouse for English Language Acquisition & Language Instruction Educational Programs.

Beltramo J. L. (2017). Developing adaptive teaching practices through participation in cogenerative dialogues. *Teaching and Teacher Education*, *63*, 326–337. https://doi.org/10.1016/j.tate.2017.01.007

Echevarria, J., Short, D., & Powers, K. (2006). School reform and standards-based education: A model for English-language learners. *The Journal of Educational Research*, *99*(4), 195–211. https://doi.org/10.3200/JOER.99.4.195-211

Hatano, G., & Inagaki, K. (1984). Two courses of expertise. *乳幼児発達臨床センター年報*, *6*, 27–36.

Heinze, A., Star, J. R., & Verschaffel, L. (2009). Flexible and adaptive use of strategies and representations in mathematics education. *ZDM*, *41*, 535–540. https://doi.org/10.1007/s11858-009-0214-4

Illustrative Mathematics. (2019). *Illustrative mathematics*. https://im.kendallhunt.com/

Schwartz, D. L., Bransford, J. D., & Sears, D. (2005). Efficiency and innovation in transfer. In J. P. Mestre (Ed.), *Transfer of learning from a modern multidisciplinary perspective* (pp. 1–51). Information Age.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. Jossey Bass Publishers.

Von Esch, K. S., & Kavanagh, S. S. (2018). Preparing mainstream classroom teachers of English learner students: Grounding practice-based designs for teacher learning in theories of adaptive expertise development. *Journal of Teacher Education*, *69*(3), 239–251. https://doi.org/10.1177/0022487117717467

Yoon, S. A., Evans, C., Miller, K., Anderson, E., & Koehler, J. (2019). Validating a model for assessing science teacher's adaptive expertise with computer-supported complex systems curricula and its relationship to student learning outcomes. *Journal of Science Teacher Education*, *30*(8), 890–905. https://doi.org/10.1080/1046560X.2019.1646063

Zwiers, J., Dieckmann, J., Rutherford-Quach, S., Daro, V., Skarin, R., Weiss, S., & Malamut, J. (2017). *Principles for the design of mathematics curricula: Promoting language and content development.* Retrieved from Stanford University, UL/SCALE website: http://ell.stanford.edu/content/mathematics-resources-additional-resources