

Developing Teachers' Adaptive Expertise for Ambitious Instruction and Disciplinary Learning

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Abstract: Since the introduction of the adaptive expertise construct many decades ago, there has been a resurgence in recent learning sciences scholarship with respect to how to support K12 teachers in adopting ambitious instruction, i.e., the discipline-specific knowledge and strategies for real-world inquiry. Such shifts require a consideration of learning theories about what teachers need to know in relation to real-world disciplinary inquiry, how this knowledge can be translated into practice, and how both kinds of knowledge engage diverse classroom communities. This symposium highlights six teams of researchers who work with in-service and prospective K12 teachers focused on understanding how best to develop their adaptive expertise for ambitious instruction. In conversation with each other and the audience, we aim to understand how adaptive expertise is conceptualized in its myriad disciplines and how it is developed through theory and practice. Of particular interest are the mechanisms that support teacher learning.

Keywords: Adaptive expertise, K-12 education, disciplinary instruction, teacher learning

Symposium overview

Introduced as early as Hatano (1982), the construct of adaptive expertise (AE) has experienced a resurgence in recent scholarship regarding how to support K12 teachers to adopt ambitious instructional reforms (e.g., Windschitl et al., 2020). Ambitious instruction asks teachers to use discipline-specific strategies that position students as sense makers in communities of inquiry (Kavanagh et al., 2017; Reisman et al., 2018) that mirror disciplinary knowledge building practices. Moreover, the complex nature of teaching requires teachers to be able to orchestrate myriad instructional and contextual variables, acknowledge multiple perspectives, and identify problems and possibilities in existing and emergent classroom dynamics (Fairbanks et al., 2010). For teachers, this requires moving to adaptive instructional approaches from their more experienced and practiced curricular and pedagogical routines (Yoon et al., 2019). Such shifts also require educational and learning sciences researchers to consider teacher learning theories that focus on what teachers need to know in relation to real-world disciplinary inquiry, how this new knowledge can be translated into practice, and how both kinds of knowledge optimally engage the diverse communities within which teachers teach (Yoon et al., 2023).

Thus, researchers have asserted that teachers' knowledge is context-dependent (e.g., van Driel & Berry, 2012). While AE can be viewed as a generalized construct, the enactment of teachers' AE will look different across disciplines as Goldman et al. (2016) assert when comparing disciplinary literacies further echoing what Hatano and Oura (2003) noted in terms of the range and variability of knowledge required to be considered an expert in any subject. Moreover, how to support teachers in developing AE in today's teaching and learning environments has evolved in terms of pedagogical goals given the complexities of our current sociocultural exigencies, e.g., global epidemics; racial injustice; and threats to the trustworthiness of science. Since the introduction of AE many decades ago, there have also been advancements in theories and tools to support teacher learning. For example, practice-based teacher education studies (e.g., Stroupe et al., 2020) have highlighted promising approaches for novice teacher induction in the disciplines. Likewise, the field of epistemic cognition has recently increased focus on working with inservice teachers to develop curriculum and instruction to support students' epistemic performance, which requires changes in routine curriculum delivery (e.g., Chinn et al., 2020). In this symposium, we highlight how scholars from these different perspectives have investigated the development of teachers' AE for ambitious instruction across disciplines. Of particular interest are the mechanisms that support teacher learning. The symposium has been intentionally curated to present perspectives on AE development and mechanisms in the areas of: 1) History instruction and coaching; 2) Math instruction and rehearsals; 3) Biology instruction and epistemic practices; 4) Elementary Science instruction developing routine and adaptive expertise; 5) English Language Arts instruction and racial oppression; 6) Math and Science instruction and interdisciplinarity.

Each presentation will highlight the manner in which AE is developed, societal or population challenges that require AE development, and how the development of AE supports improved instruction. Additionally, across the six studies we will surface commonalities that can serve as collective goals for future research in AE studies.

Structure of symposium

To demonstrate the range of applications, symposium presenters will present both theoretical and empirical research. The symposium will be structured to allow conversations between presenters and the audience about the collective emerging scholarly work, with the ultimate goal of mapping current and future possibilities for advancing the field of adaptive expertise for ambitious instruction and disciplinary learning. The symposium will be conducted as a structured poster session with a 2-minute welcome and introduction from the chair and 1 minute summary introductions from each of the presenting groups. The session participants will then rotate between posters in 7-minute intervals with the remaining 10 minutes of the session devoted to interactive discussion between the participants and presenters.

Examining differential development of adaptive expertise in novice history coaches through the lens of role-identity

Abby Reisman & Lindsey Graham

Coaching is an essential component of professional development for ambitious instruction (e.g., Kraft et al, 2018) and, like teaching, demands adaptive expertise, or the ability to use one's knowledge and reasoning to assess and respond to novel problems in flexible ways. Yet, the field lacks models for novice coaches development (Gallucci et al., 2010). This paper examines the motivation of two novice history coaches through the lens of the Dynamic System of Role-Identity (DSMRI) and asks: *What role-identity tensions support the development of adaptive expertise in coaching for ambitious history instruction?*

The DSMRI views an individual's socially situated role-identity (e.g., coach) as a complex dynamic system comprising four components: (a) ontological and epistemological beliefs; (b) purposes and goals; (c) self-perceptions, and (d) perceived action possibilities. These continuously emerge within four parameters: culture; social context; individual dispositions; and the domain of activity. The DSMRI suggests one (often implicitly) selects among action possibilities that achieve alignment and coherence with one's goals, dynamic lived realities, and shifting self-perceptions. Learning to coach adaptively reflects change to the content of or relations among these role-identity components (Garner & Kaplan, 2019; Gunersel et al., 2016).

This comparative case study follows two novice history coaches, Alex and Jared, over the first two years of design-based implementation study in a district developing an instructional coaching program around disciplinary historical inquiry. Data sources included 7 interviews with each coach, as well as over 40 hours of design sessions with the full cohort of coaches (N=10). Data was coded following the DSMRI Manual for narrative analysis through deductive and inductive steps (Kaplan & Garner, 2020).

Alex maintained a fairly stable novice coach role-identity that reflected alignment between his goals for teachers related to student-driven historical inquiry, his belief about its value, and his self-perceptions as

knowledgeable about the approach and curriculum. His core role-identity tension across the two years reflected misalignment between his goal to engage his teachers in “reflective feedback and questioning” and his limited action possibilities: being “direct,” for example saying, “you should do this and not that.” In Year 2, he proposed programmatic changes to deepen teachers’ understanding of the goals of inquiry, and he developed pedagogical action possibilities that allowed him to “sit back and listen” instead of “jumping up right away and saying, ‘Hey, here’s what I see.’” Jared, by contrast, had a narrower understanding of the curriculum as focused on historical thinking skills, rather than student-driven inquiry. These underdeveloped goals, combined with low confidence and repeated insistence on his lack of expertise, made him initially hesitant to “give feedback or . . . make suggestions” to his teacher. Even in Year 2, he wondered “who am I to tell this teacher ‘I know to make this move or whatever else.’” He ultimately resolved his identity tension by withdrawing from the program: “It’s one of those things. . . maybe I’m not a coach.” These findings have implications for the design of adaptive coach learning experiences that center identity exploration and motivation.

Developing adaptive expertise in the wake of rehearsals

Erin E. Baldinger & Jennifer Munson

Teachers need to develop as adaptive experts to address the “problem of complexity” that ambitious teaching presents (Hammerness et al., 2005). Practice-based teacher education can preserve this complexity. For instance, rehearsals allow teachers to study and enact practice with one another. Practice-based teacher education and adaptive expertise are conceptually intertwined but would benefit from a stronger coupling (Janssen et al., 2015). Current research on rehearsals has primarily focused on how this pedagogy might support the learning of the rehearsing teacher. However, rehearsals are intended to support learning for all participants, including the non-rehearsing teachers (NRTs) who act as students. We focus on the debrief discussions that follow rehearsals as a potential site for developing adaptive expertise, as interaction can spur innovation (Schwartz et al., 2005). We contend that the development of adaptive expertise may be connected to the constructs of teacher noticing and teacher position, which we draw on to analyze the debriefs.

In this study, we develop an emergent model of how post-rehearsal debriefs can reveal and support the development of adaptive expertise for NRTs. We ask: In what ways do rehearsal debriefs provide opportunities for NRTs to develop adaptive expertise? We examined eight rehearsal debriefs from a professional development institute for 22 in-service secondary mathematics teachers. Debriefs each lasted approximately 20 minutes and were recorded and transcribed. We coded NRT talk for position (Harré & van Langenhove, 1991) and utterances that functioned as attending and interpreting (Sherin et al., 2011), and implicating, with emergent sub-codes for each. We used our codes with the transcripts to develop a model for NRT adaptive expertise. Debriefs provided opportunities for NRTs to socially construct adaptive expertise through making their experiences public and considering implications for teaching. NRTs first shared the experience of participating as students in a rehearsal. During the subsequent debrief, largely from their position as students, NRTs attended to and interpreted moments from the rehearsal, creating a public pool of data. NRTs also drew implications through reconsidering previous practice and engaging in thought experiments, demonstrating cognitive flexibility and case sensitivity (Feltovich et al., 1997). When implicating, NRTs were more frequently in their positions as teachers.

The implications NRTs made were tightly linked to the data they generated—evidence of data-driven forward reasoning. Importantly, NRTs moved frequently back and forth between noticing and implicating, at times even within a single talk turn. This process resulted in collective co-construction of new ideas. The debrief discussions as a whole represent opportunities for sociocultural, discursive learning.

Debriefs play a critical role in rehearsals, providing opportunities for NRTs to develop adaptive expertise through making their experiences public and considering potential implications for teaching. The model that emerged from our analysis more closely ties the development of adaptive expertise to practice-based teacher education and highlights the social construction of adaptive expertise. These findings suggest that teacher educators should frame rehearsal debriefs as essential platforms for NRTs’ learning.

Instructional Epistemic Frames in Professional Development of High School Biology Teachers

Susan A. Yoon, Clark Chinn, Thomas Richman, Noora F. Noushad, Huma Hussain-Abidi, Kyle Hunkar & Zhitong Yang

Science teachers need strategies that can support students to develop scientific epistemic practices to accurately evaluate information (Darnier, 2019; Duschl, 2020). This is particularly pressing given the unprecedented misinformation foment that has exacerbated the challenge of science denialism (Gorman & Gorman, 2021; Sinatra

& Hofer, 2021). Ensuring that students understand how scientific inquiry produces reliable data, for example, requires teachers to instruct with strategies that Ford (2015) calls “a grasp of practice”. It requires teachers to have a well-formed understanding of how scientific knowledge advances in the real-world and an ability to translate this understanding into classroom instruction—both essential components of adaptive expertise and ambitious instruction (Yoon et al., 2023).

In this study, we introduce Instructional Epistemic Frames (IEFs) that encapsulates aspects of practice-based teacher education research (e.g., Reisman et al., 2018; Windchitl et al., 2020) and emerging studies in the field of epistemic cognition (e.g., Chinn et al., 2020). IEFs are comprised of teacher discourse moves that:

- Anchor learning in scientific ideas that are familiar to students (e.g., “How many remember the different advice we were given at the beginning of the COVID pandemic?”)
- Elicit student ideas that are shared and evaluated with peers (e.g., “What advice did you and your family follow and why? Turn and talk with a partner.”)
- Orient students to epistemic norms of the discipline (e.g., “Scientists researched multiple types of vaccines in labs all over the world comparing different methods to find a collective solution.”)
- Orient students to epistemic practices that produce disciplinary knowledge (e.g., “In the aggregate, ample data ensures that solutions are not based on chance outcomes.”)

We worked with 12 science teachers in summer 2023 who were experts in teaching with an agent-based modeling curriculum in high school Biology. Through decompositions of classroom videos (Grossman et al., 2009), our research question examined the extent to which IEFs enabled a change in teachers’ understanding of instruction on epistemic practices. Using the method of Interactional Analysis (Jordan & Henderson, 1995) we coded six hours of recorded PD discussions.

Results demonstrated: 1) A shift in supporting students’ epistemic performance. In debriefs, one teacher remarked, “When sharing their science explanations, student teams need to be asking each other, what data supports your ideas and how did you gather it rather than simply asking what did you get?”; 2) Overwhelming support for the use of IEFs to adapt instruction. In a post-workshop survey, one teacher wrote, “I loved going through the epistemic frames with our videos to really see spaces where we can enhance instruction. It was clear looking back where there were missed opportunities”; 3) Pedagogical transformational change. This teacher said, “My whole year will be about epistemic practices. Students just need experience over and over again to practice reliable data collection.

We believe the use of IEFs in PD is exceptionally promising to support teachers’ adaptive instruction. In the coming year, we aim to investigate whether and how IEFs were deployed in the classroom and how they improved student epistemic performance.

In-Service Teacher Adaptive and Routine Expertise in Elementary School Science Reforms

Nicole Bowers

Hatano & Inagaki’s (1986) original research on adaptive and routine expertise as well as education-specific interpretations were employed to demonstrate AE moves in the science classroom, a change necessary for reforms in elementary schools, as teachers make pedagogical adjustments (Bybee, 2014; Hammerness et al., 2005; Reiser, 2013; Yoon et al., 2015). Changing traditional science teaching practices to ambitious instruction is a challenge for in-service teachers. Roehrig et al. (2007) characterize traditional science teaching as not allowing students to formulate their own questions and teachers providing information directly, driven by teachers’ assumptions that inquiry-based pedagogy takes too much time and runs the risk of students not arriving at the right answer. Traditional approaches can be described as routine expertise (RE) while adaptive expertise (AE) is characterized by allowing student agency, student-centered science discourse, and adapting to emergent student understanding (Allen et al., 2013; Lee et al., 2014; Mulvey et al., 2016; Zhang et al., 2011). This study looks closely at teachers’ enactments of reformed based curriculum to identify the challenges and opportunities in moving current practice toward ambitious teaching through understanding how AE and RE manifest in elementary science classrooms (Schneider et al., 2005; Windschitl et al., 2020).

Across five cases, characteristics of AE and RE were compiled whilst highlighting individual cases of AE and RE in this multiple-case replication study (Yin, 2007). Five teachers participated in the same PD in which facilitators demonstrated AE moves. Data sources for this study were video of participants enacting the lesson *Producing Electricity*, one of eight provided in PD, as well as written teacher reflections post-enactment. Transcripts were analyzed using qualitative content analysis (Miles & Huberman, 1994), and a code book was developed through inductive and deductive coding iterations using constant comparison (Cresswell & Miller, 2000; Glaser & Strauss, 2017).

Based on best practices for reform, this study develops and refines the characteristics of AE and RE. It adds to examples of allowing student agency, responding to emergent understanding, and facilitating science discourse that reinforce and resonate with ambitious instruction (Allen et al., 2013; Lee et al., 2014; Mulvey et al., 2016; Yoon et al., 2015; Zhang et al., 2011; Windschitl et al., 2020). Findings also echo others that curricular support can help teachers make pedagogical transitions (Davis, 2002; Remillard, 2000). Additionally, this study shows that teachers often miss opportunities to engage students in inquiry showing neither AE or RE.

Although this study focused first on AE, RE surfaced as a challenge to shifts in pedagogy toward ambitious instruction. Findings suggest that RE may be particularly prevalent among experienced teachers. Despite new curricular material and PD that emphasizes AE, the most experienced teachers intentionally added vocabulary memorization and employed direct teaching. The study also illuminated that no one teacher is an adaptive or routine expert; rather each teacher demonstrated both AE and RE in differing proportions. These findings suggest that PD should elicit prior practice as RE needs to be explicitly addressed with in-service teachers before moving to introducing and practicing AE.

Reinforcing or disrupting oppression?: Instructional dilemmas faced by ELA teacher candidates

Sarah Schneider Kavanagh, Elizabeth Gotwalt & Amy Guillot

Most scholarship on adaptive expertise in teaching focuses on how teachers use judgment when facing problems of content learning. However, along with content learning problems, teachers consistently manage dilemmas relating to race and power in classrooms. To date, however, adaptive expertise has rarely been used as a lens through which to analyze such issues. This is a striking oversight given that teacher candidates (TCs) often struggle to disrupt the impact of racial power structures on their teaching (Braunstein et al., 2021; Kohli, 2014; Meier, 2019). We investigate that tension, asking: *What dilemmas arise for teacher candidates as they consider how to disrupt racial oppression within their instruction?*

Along with grounding our work in scholarship on adaptive expertise, we also draw on conceptualizations of oppression as a structural phenomenon in which established practices and norms systematically privilege some racialized groups at the expense of others (Lopez-Fogues, 2016) specifically operationalizing Young's (1990) "five faces of oppression" framework as a coding framework. Our perspective on instruction is grounded in Cohen et al.'s (2003) "instructional triangle," which sees teachers, students, and content as in a triadic relationship existing within an environmental context. We also draw on Lampert's (1985) conceptualization of instruction as "dilemma management," which requires adaptive expertise: the ability to engage reasoning to make responsive decisions (Hatano & Inagaki, 1986).

Data for this study were drawn from a secondary English Language Arts (ELA) methods course during the fall of 2020. The primary data source was recordings of the virtual class sessions of the methods class (n=12); supplemental data included lesson plans, course artifacts, instructor reflections and interviews, and TC focus groups. By identifying the co-occurrence of codes derived from Young's (1990) five faces of oppression framework, Cohen et al.'s (2003) instructional triangle, and Lampert's (1985) conceptualization of instruction as dilemma management, we identified and analyzed episodes that illustrated the intersections of racial oppression, TC sensemaking, and instruction.

Our analysis revealed that attempts to disrupt the flow of racially oppressive forces along one edge of the instructional triangle often caused the unintended reinforcement of oppressive consequences along other edges of the instructional triangle. For example, TCs in this study wanted to disrupt cultural imperialism and student powerlessness by engaging students in discussions about texts written by and about people in minoritized racial groups. However, they feared that this might reinforce other oppressions through racist comments shared by students. Furthermore, our analysis revealed that teachers' attempts to disrupt racial oppressions in one dimension of their instruction often reinforced oppression in another. For example, when TCs engage students as sensemakers (Aukerman, 2006) and elevate texts from outside the canon (Ebarvia, 2018); they run the risk of opening the classroom door to racist ideas (Leonardo & Porter, 2010). This work highlights the complexity of adaptive expertise in teaching when it comes to the difficult work of disrupting the way that racial power, privilege, and oppression operate in classrooms.

Understanding and developing primary teachers' adaptive expertise in interdisciplinary mathematics and science

Amanda Berry, Jan van Driel, Colleen Vale, Wanty Widjaja, Lihua Xu, Joe Ferguson, Lam Pham & Jinny Kim

Research has demonstrated that teaching science and mathematics in interdisciplinary ways, related to real-world problems can enhance children's engagement and deeper learning of disciplinary knowledge (Czerniak & Johnson, 2014) and facilitate the development of twenty-first century skills such as problem solving and creative and critical thinking (Li et al., 2019). The shift from disciplinary to interdisciplinary approaches to teaching and learning and the focus on teaching for twenty-first century skills requires teachers to become proficient at the skills themselves and to develop expertise across traditional disciplinary boundaries. Teachers need to become adaptive experts who are accustomed to unfamiliar, unexpected and complex situations and can apply professional knowledge flexibly, innovatively and creatively in such teaching situations (Hatano & Inagaki, 1986).

In Australia, primary teachers are trained as generalists through disciplinary-based approaches. Hence, primary teachers tend to lack understanding to connect mathematics and science in meaningful ways to promote student interdisciplinary learning (Timms et al., 2018). Therefore, to design and implement professional learning initiatives that effectively support primary teachers, a better understanding of the development of adaptive expertise for interdisciplinary mathematics and science teaching is needed. This study aims to improve theoretical and practical understanding of the nature and development of teachers' adaptive expertise in interdisciplinary mathematics and science in primary education.

The study is designed as a small scale, longitudinal intervention study tracking primary teachers from five Australian primary schools over three years. In each year of the study, teams of teachers in each school co-plan, co-teach and co-reflect on two sequences of three interdisciplinary mathematics and science lessons. Lessons are videotaped using 360° cameras. Each teacher team reviews their video recordings together, to identify critical moments for students' learning that occurred. Members of the research team meet with the teachers to discuss the identified moments as well as ideas about changes teachers would make to the lesson sequence in subsequent teaching, based on their experiences. Longitudinal tracking of the same teams of teachers in each school allows us to capture the developmental processes of adaptive expertise and individual variations in the components and levels of adaptive expertise between teachers.

Findings from Year 1 are indicative of differences in teachers' adaptive expertise, for instance in terms of flexibility and deeper level of understanding. Also, and related to this, differences are apparent in teachers' own confidence and capabilities, particularly related to subject matter knowledge (both in mathematics and science). The data demonstrate how peers (i.e., team members) and tools (i.e., 360 video) are instrumental to make adaptive expertise explicit and visible. Currently, data analysis is ongoing to characterize these findings further in terms of components and levels of teachers' adaptive expertise. Data analysis is also aimed to understand how teachers' adaptive expertise is influenced by contextual constraints such as school expectations about lesson planning, or student behavior.

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