

Expansive Ways of Knowing and Improving: Using Equity Tools and Approaches to Support Equity of Participation in Learning Activities

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Abstract: This symposium brings together projects that are developing and testing equity analytics in education. Equity analytics are a genre of learning analytics that attends to the distribution of and participation in opportunities to learn, with attention to inequities linked to students' social identities and wider systems of marginalization and oppression that impact classrooms and schools. Each of the projects has engaged not only in developing tools for gathering data related to inequities of participation but also for helping educators take action to reduce inequities in their classrooms and schools. Findings generated from each project illustrate how, through working in close partnership with educators, equity analytics systems can be developed that are feasible to use and that can inform practice. These projects also underscore the challenges of implementing equity analytics within inequitable systems that emphasize goals of accountability and with educators with varied conceptions of what constitutes equitable participation and learning.

Symposium overview

Reinholz and Shah (2018) first introduced equity analytics as a quantitative approach to analyzing aspects of equity and inequity in classrooms. Their initial work demonstrated the potential of a practical tool for documenting and visualizing inequities in classrooms, which they defined as misalignments in distribution of participation and opportunities for participation in classroom learning activities (Shah & Lewis, 2019). Since then, researchers have expanded scholarship in equity analytics, exploring the participatory design of equity analytics systems (Campos et al., 2023), the role of visualization in supporting noticing for equity (Raza et al., 2020), and sensemaking with and use of equity analytics to inform pedagogical change (Ahn, Nguyen, & Campos, 2021; Campos et al., 2023; Nguyen, Campos, & Ahn, 2021; Raza, Penuel, & Salinas del Val, 2022; Reinholz, Reid, & Shah, 2022). In addition, the focus of equity analytics has expanded beyond participation, to take up matters of students' experience of the classroom and system-level inequities in opportunities to learn (Penuel & Watkins, 2019).

As learning analytics comes to center equity more, Uttamchandani and Quick (2022) argue that the field needs to engage with critical approaches to equity that situate analytics within larger sociopolitical value systems and infrastructures. Equity analytics, for its part, they argue, need to point toward transforming the structures that produce inequitable experiences and outcomes in the first place. Indeed, to realize the original promise of equity analytics for influencing policy and practice at a larger scale will require that the design, visualization, and use of analytics cultivate opportunities for engaging in what Campos and colleagues call "generative uncertainty"—a stance of productive inquiry toward data—regarding the role of systems in reproducing inequities. A challenge that each of these projects is seeking to meet is to ensure that equity analytics can both fit within the existing routines of schools, while also seeking to transform them (Campos et al., 2023).

Particularly important to consider in fitting within today's schools is how to support productive conversations about data within systems that today stress accountability rather than improvement. Routines that support data-driven decision making with achievement data ubiquitous in schools today (Mandinach & Schildkamp, 2021). The ubiquity of these routines is explained in part by how they support accountability policies focused on reducing achievement gaps (Mehta, 2013). Conversations involving these data, rather than yielding new ideas for how to promote equity in classrooms, tend to reproduce deficit-oriented conceptions of students (Bertrand & Marsh, 2021; Horn et al., 2015). Centering conversations on pedagogical decision-making and

reasoning requires building a culture of inquiry that both presents educators with data on inequities in their classrooms and invites them to see new pedagogical possibilities.

In this symposium, scholars from multiple initiatives conducted in partnership with educators and leaders in systems from K-12 to higher education describe their efforts to design, visualize, and support use of equity analytics to promote systems-level changes in teaching and learning in school-based contexts in the United States. These projects span different fields, but each has been carefully designed to create a context for meaningful educator inquiry into both inequities in teaching and possibilities for supporting more equitable learning environments. We identify both the affordances and limitations of different approaches to design, visualization, and use. In addition, we highlight the ethical and sociopolitical dimensions of equity analytics, to articulate practical design knowledge (van den Akker, 1999) for the field.

Following an introductory framing of the session, each author team will present their work, highlighting the contributions to the field of equity analytics, puzzles and tensions arising from their research, and plans for future inquiry. After each presentation, two different discussants, one from Australia and a second from Europe, will offer comments on the significance and potential for applicability of findings to their contexts, followed by a question and answer period. The symposium will include time for participants to then engage briefly with some aspect of the equity analytics tools and systems one of the paper teams has developed (e.g., a protocol, survey, and/or visualization tool).

Beyond verbal: A practical measure of embodied classroom participation

Daniel L. Reinholz, Cathery Yeh and Hakeoung Hannah Lee

Research highlights how embodied, multimodal engagement is an important aspect of communication and learning. However, there are currently few tools to capture such engagement in a classroom setting, especially in ways that are low-cost, easy to implement, and consequential for improving teaching practice (i.e., practical measures). Here, we briefly discuss the collaborative development of a practical measure to capture embodied participation. We worked with four instructors in elementary mathematics classrooms, who were working with students with multiple marginalized identities: students of color, emergent bilinguals, and students with disabilities. Our collaborative design process supported the creation of a new tool based on the EQUIP observation methodology, which captures inequities in the distribution of opportunities to participate in classroom activities (Reinholz & Shah, 2018), that could generate actionable, multimodal data that the teachers found was actionable in their specific contexts.

Our work is grounded in a situated perspective of learning, with a particular emphasis on how the body and other resources in the environment support the production and communication of meaning (Goldin-Meadow et al., 1993). For example, this line of research highlights that student gestures are not mere appendages to *formal* reasoning; rather, embodied actions can provide insight into students' understandings that they are not yet able to articulate verbally. Accordingly, teachers need tools to recognize and build upon students' nonverbal engagement. In our work, we use the term *beyond verbal* participation, to emphasize the importance of nonverbal engagement, which is typically sidelined in favor of verbal-only contributions. We find it particularly important to disrupt the preponderance of verbal discourse that is prevalent in mathematics education, and in schools writ large. This singular focus can often be a marginalizing force in schools, because accepted ways of communicating mathematical ideas are narrowly prescribed and controlled. This is particularly true for multiple marginalized youths, who may be denied access to mathematics learning due hegemonic forms of expression (e.g., talk in English only). Alternative forms of engagement can support agency for disabled students and emergent multilinguals, if tools can be developed to support teachers to leverage and encourage engagement beyond verbal communication.

The current work emerged from a research-practice partnership with four elementary school teachers working in a racially, ethnically, and linguistically diverse school district. We intentionally selected a school district and teacher partners who were already grappling with issues of bias and racial inequities in their school context. The teachers participated in collaborative redesign as a part of a yearlong learning community focused on anti-bias mathematics teaching and universal design for learning. Together, the teachers and research team worked to design a useful measure that could capture students' beyond verbal engagements in a way that was consequential for teachers and their classrooms.

In this paper, we focus on the redesign of the EQUIP measure to capture representations that embody mathematics concepts (cf. NCTM, 2000). By design, EQUIP was created as a tool that would allow teachers and researchers to understand how classroom participation is distributed across students according to a variety of social marker identities. Thus, rather than simply providing information about the classroom *as a whole*, EQUIP data are disaggregated at both an individual and group level. A key affordance of this disaggregation is that it

fosters more teacher reflection on student social marker identities, such as race and gender, which teachers are more likely to avoid in the absence of such data (Shah et al., 2023). In addition to standard EQUIP codes, we developed *beyond verbal* codes to capture multimodal participation, and build-on codes to capture how students built on one another's ideas.

We discovered that a traditional, verbal-only tool would've captured less than half of student public participation. A total of 52% of coded student contributions were beyond verbal. Furthermore, we identified that 64% of instances in which students were building on one another's contributions, they were building on beyond verbal contributions. We hypothesize that the beyond verbal contributions made student thinking more publicly accessible to other students, thereby facilitating a process of building on. As our field continues to grapple with how to design and use measures like this one with teachers, our collective knowledge of practice and theory about beyond verbal engagement will continue to deepen. At the same time, we will need to continue to support educators and students alike in coming to appreciate forms of participation that go beyond the verbal.

Using data on students' experience in science to support equity of participation in knowledge-building activities

Ali Raza and William R. Penuel

A *Framework for K-12 Science Education* (NRC, 2012) presents a vision for promoting equity through engaging students in building knowledge together to explain phenomena and solve problems that are of personal and community relevance. To support teachers in realizing this vision, over the past four years, we developed and tested a strategy for data-informed decision-making called the *Student Experience Improvement Cycle (SEIC)*, which engages groups of educators and a coach in (1) individual and collective sensemaking related to data on students' experience learning; (2) adapting evidence-informed practices for supporting equitable classroom talk and for enhancing the relevance of instruction; (3) testing these instructional practices in their classrooms; and (4) evaluating their short-term efficacy in improving classroom practice and student experience in the classroom (Penuel, Raza, & Salinas del Val et al., 2024).

Our SEIC strategy uses a novel system for collecting and visualizing student experience data using the Science SEET system (<https://www.scienceset.com/>, Raza et al., 2021). The exit tickets included are a type of practical measure designed around constructs that are central for students' meaningful engagement in science practices: a focus on students' understanding of the reason for engaging in practices (Reiser et al., 2017), the relevance of the lesson to their lives and importance to their communities (NRC, 2012; Tan & Calabrese Barton, 2012), and their sense of agentive contribution to knowledge-building (Stroupe, 2014). Exit ticket items ask students questions at the end of the lesson related to three constructs or aspects of experience, such as "We work together to determine what ideas are most persuasive" (coherence), "The teacher invites us to share our experiences or ideas about a topic" (relevance) and "The teacher encourages us to build on and critique one another's ideas" (contribution). The Science SEET system and the Inquiry Cycle of the SEIC bring together student data derived from theoretically informed practical measures, an interface that provides flexible displays of data for formative assessment and instructional decision-making, and research-based classroom strategies in a professional learning cycle with coaches and peers.

The SEIC is a cycle based on the Plan-Do-Study-Act cycle (Bryk et al., 2015) that engaged teachers in adapting evidence-based strategies for promoting more equitable small-group and whole-class knowledge-building activities. It consisted of four sessions spread across two months to implement these instructional changes in practice to improve the students' experiences associated with race/ethnicity and gender. In session one, teachers learned about focusing on three constructs of students' experience and thinking expansively about them, learning about the use of the data collection tool, the Science SEET system. In the second session, teachers formed small groups of 3-5 to adapt and test the instructional strategies related to the three constructs (aspects) of experience. Then, in the third session, teachers engaged in sensemaking about their data from instructional changes and created new improvement goals for implementation before the last session. In the last and fourth session, researchers shared improvement data with teachers of all the small groups for reflection from baseline to intervention. Then, teachers reflected on the efficacy of the implementing strategies in light of three constructs of experience and logged their decisions building from evidence.

We tested the SEIC in a study of forty-nine middle school science teachers remotely in two cohorts over a course of one year. The educators in the study tried out multiple strategies for promoting more equitable learning environments—fostering a culture of collective knowledge-building, promoting student agency over the direction of their learning, and helping students see the arc of their own learning. Their efforts proved promising, in terms of altering students' experiences of science learning. Fitting hierarchical linear models to data on student experiences over time, we found that over the course of participation in the SEIC, students' perceptions of

coherence increased in one cohort and their perceptions of relevance improved in another. Specifically, we found that for the first cohort, Asian American, Native Hawaiian/Pacific Islander, and white students' perceptions of coherence and for the second cohort, Black students' perceptions of relevance grew faster than other students' perceptions of relevance. Educators who continued to work with researchers on their own made gains after the conclusion of the series, suggesting the need to adapt the SEIC approach in multiple cycles to improve the equity of outcomes and allow for more sustained engagement with student experience data.

This study shows that educators' efforts to test strategies in their classrooms grounded in research for promoting coherence can support improvements to students' experience of their science learning. Each of the strategies have been established as promising in a variety of studies of student sensemaking in science (e.g., Sikorski & Hammer, 2017), collaborative knowledge building (e.g., Damşa et al., 2010), and experimental intervention studies (Damşa et al., 2010). An area for future inquiry in our study is why some student groups benefited more than others. While the mere fact that student patterns of experience and growth in their experience might vary by race/ethnicity is not surprising, it also points to the fact that attenuating inequities of experience is complex work and requires attention to different experiences of individuals and groups in classrooms. Future ethnographic and qualitative studies are needed to explore why this might be the case for this variability in improvement when these strategies are intended to promote collective knowledge building within a cycle of inquiry to support equity of experience.

Additional challenges to the work pertain to teachers' own positionalities and preferences for data visualizations for making sense of data. Educators brought a range of positionalities and beliefs about what counts as "equity" based on their local context. In some cases, they preferred to examine how experiences varied by race/ethnicity or gender, but not both. Also, we found that when we provided educators with visualizations showing overall patterns of experience by question and with disaggregated data, educators preferred visualizations that did not break down differences by race and gender, primarily because they said those visualizations were easier to interpret and use (Raza et al., 2024). Future research should investigate how teachers' own positionalities and views of equity shape their sensemaking and investigate how visualizations that disaggregate data by race/ethnicity and gender might be made more usable and useful to educators.

Possibilities and tensions in using practical measures to enable equity-oriented instructional improvement in mathematics

Kara Jackson and June Ahn

Redressing long-standing inequities in students' opportunities to engage in rich, personally meaningful mathematical activity remains a persistent challenge in the U.S. Doing so requires, in part, sustained teacher professional learning opportunities, in which teachers are supported to interrogate their current practice, learn about alternatives, make principled decisions about what to try next, and examine the impact of their decisions on students' learning and experiences (Cobb et al., 2018). In this paper, we focus on both the contributions that practical measures can make to instructional improvement efforts that aim to address this issue, as well as tensions that emerge, by drawing on our work in the Practical Measures, Routines, and Representations (PMRR) Project (2015-2023; <https://www.pmr2.org/>).

PMRR consisted of three research-practice partnerships. In each, a team of university-based researchers partnered with educators in a large school district that was actively involved in equity-oriented efforts to improve middle-grades mathematics teaching and learning. Each of the districts provided ongoing cycles of professional learning for teachers, which took the form of one-on-one coaching cycles or collaborative professional development. One aspect of our work concerned the co-design of *practical measures of key aspects of the classroom learning environment* that prior research indicates make a difference for students' learning and identities (Jackson et al., in press). Practical measures are intended to provide educators with minimally burdensome ways to gather frequent feedback about targeted aspects of their practice, to inform ongoing adjustments (Takahashi et al., 2022). The student-facing classroom measures take the form of quick surveys. Alongside the measures, we co-designed routines for administering the classroom measures and analyzing the resulting data and a data visualization platform that facilitates educators' analysis and productive use of the resulting data (Ahn et al., 2021). In the context of ongoing professional learning, teachers interpreted students' perspectives, alongside additional data like student work, to investigate the impact of their instructional decisions on students' experiences and learning, and to identify potential next steps for their practice.

We studied the integration of the practical measures and associated routines and data visualizations in the various professional learning initiatives in each of our partner districts (e.g., Campos et al., 2023, Ing et al., 2021, Jackson et al., in press). In doing so, we identified a set of equity-specific contributions that practical measures can make to instructional improvement efforts. For example, in a study of the integration of classroom

measures in one-on-one coaching cycles, Kochmanski (2020) found that the use of the practical measure data appeared to enhance the depth and quality of teachers' analysis of the impact of their instructional decisions on equity in their students' experiences and learning, and the specificity of the goals teachers and coaches identified for future instruction. Moreover, teachers reported gaining valuable insights into students' perspectives that otherwise would have remained out of view and that have important equity implications (e.g., whether students were able to make sense of each other's ideas, students' sense of whether their peers valued their ideas in the lesson, students' comfort in sharing their ideas). Coaches across districts reported that analyzing students' perspectives with teachers provided them with important insight into teachers' assumptions about students and their capabilities, assumptions that teachers may have otherwise refrained from sharing (e.g., Jackson et al., 2022).

At the same time, our co-design efforts and investigations of use of the classroom measures across districts surfaced a number of equity-specific tensions. One tension concerns the prevalent norms around privacy and power relations associated with the organizational and political context (Coburn & Turner, 2011). For example, in one of our partner districts, teachers and coaches initially resisted use of our team's data visualization platform, for fear that the classroom measure data would be used by administrators for evaluative purposes. Instead, teacher-coach dyads used single-use Google form representations, and therefore were not easily able to investigate trends over time (Ahn et al., 2021). A second tension concerns the representation of specific groups of students in learning analytics. Most educators indicated that the opportunity to investigate differences in students' perspectives by racial, ethnic, gender, linguistic, and disability identities and/or markers was important to their ongoing efforts. However, doing so raised issues of student anonymity, especially in cases in which few students shared specific identities within a classroom. In one district, with guidance from our team, educators decided that it was only appropriate to disaggregate by student identities if there were at least five students who shared that identity in a given classroom. Moreover, they decided to investigate such patterns across classrooms rather than within a specific classroom, to maintain student anonymity. They recognized, however, that these decisions also limited the depth of their inquiry into specific groups of students' perspectives. A third tension concerns the social routines for making sense of the resulting data (in our case, students' perspectives). As indicated above, teachers' assumptions about their students' capabilities and their associated instructional visions became apparent as teachers interpreted the resulting data (Jackson et al., 2021). Occasionally, teachers' assumptions about students reflected deficit orientations, namely that "those" students were not capable of engaging in sense-making processes in mathematics. We worried that teachers' interpretations might further reify—rather than problematize—deficit views of students. In response, our team co-designed protocols that encouraged explicit discussion of norms for shaping the orientations educators enact towards one another, and towards students.

The tensions we encountered in our work could be viewed as obstacles to integrating equity-focused practical measures into efforts to improve advance equity in students' engagement in rich, personally meaningful mathematics. We have found, however, that each of these tensions has provided fodder for critical conversation with our partners and has catalyzed innovations in the design of routines and tools that accompany the use of the specific measures. For example, tensions around privacy and trust in the use of the data visualization platform led to the creation of a collaborative workspace whereby educators fluidly opt in and out of sharing their data with other educators (Campos et al., 2023). These tensions also underscore a dilemma in equity-oriented practical measurement. Namely, practical measurement is intended to be easily integrated into educators' existing practices. Yet, the goal of the broader change efforts (and thus the practical measurement) is often to support substantial change in those existing practices.

Leveraging generative artificial intelligence (AI) to develop equity analytics of students' skills

June Ahn

The rise of generative AI and large language models have sparked a rush of debate and scholarship about how to best utilize these new tools in educational settings (Doroudi, 2023). In the following paper, we present on the first-year of a research-practice partnership where our research team and a local, urban school district has been co-designing an AI-powered equity analytics tool. From the district perspective, their organizational change goal focused on moving teachers away from primarily examining standardized test score data to understand students' learning and progress. Instead, the partner district developed an organizational mission to focus on a set of competencies – Collaboration, Critical Thinking, Compassion, Communication, and Creativity – or what the district referred to as their 5C Framework. A key obstacle in their process of changing organizational routines for teachers to attend to these competencies hinged on the lack of easy-to-use indicators of these 5Cs that fit into teacher routines.

For this critical need, the notion of practical measures (Takahashi et al., 2022) became a key focal point of mutuality in our RPP. Our research team recognized an opportunity to experiment with large language models, such as Open AI-ChatGPT, to develop practical measures of these competencies and subsequently to examine how these data points could be taken up by teachers as they understand their students' learning. Beginning in January 2023, we have been co-designing AI models to develop equity analytics around the 5Cs with our district partner, and in Fall 2023 launched a pilot implementation that has currently been used by 20,000 students and 1,000 teachers in our partner district. In the following presentation, we make two contributions to the evolving discourse about equity analytics and educational improvement.

First, we demonstrate how the design of AI models – specifically the ways in which we train and prompt large language models like OpenAI – can reflect equity frameworks or perpetuate traditional notions of supporting learners. We draw from critical, sociocultural approaches to learning (Esmonde & Booker, 2016) and cultural funds of knowledge (González & Moll, 2002) to guide the design of our equity analytics. We highlight how our RPP began to meld broader goals from critical, sociocultural understandings and improvement science, to inform our overall strategy. For example, attending to power and a commitment to building from students' everyday and existing funds of knowledge, our RPP aimed to create a tool that centered student voice and their narratives. From the teachers and organizational standpoint, the tool also had to be practical in the sense of easing data collection, analysis, and visual presentation of student data in ways that fit into the routines of the teachers (hence the focus on practical measurement). The resulting AI tool that we designed asks students to reflect on carefully designed prompts, and share stories from their everyday or school experiences, that they feel reflect the different competencies (e.g., critical thinking, creativity etc.). The students provide quick (30 seconds etc.) audio responses, and our AI system automatically transcribes and analyzes the audio responses. The AI analysis is built upon an intentional prompt engineering infrastructure, that seeks to pull out examples of the competencies from students' own perspectives and everyday stories. Developing a system of AI prompts and analysis models from sociocultural and funds of knowledge approaches offers unique insights into the design potential of large language models that can value student and local perspectives on competencies.

Second, our RPP developed dashboards for the district teachers to then engage with the student data and subsequently inform conversations about how to better support students around the 5Cs (Ahn et al., 2019). Here, we will present on the mutual blending of partnership routines and dashboard design to facilitate an organizational change process. For example, our case study illuminates how careful coordination with our district partner – leveraging their local expertise on how to mobilize a system of instructional coaches, teacher leaders, district events (such as an all-day professional development expo that is run by teachers each year), along with district leaders' messaging, framing, and marketing of the RPP across the district – was integral to setting the conditions of use for these new AI-generated analytics. In addition, our case will highlight the variety of tensions that arise organically that range from the need to build AI literacy at scale for teachers across the district, and addressing ethics and privacy concerns about AI, to alleviating teacher concerns about attending to this new form of data. These partnership routines then set the stage for understanding teacher sensemaking with our data (Campos et al., 2021). We present on interviews conducted with approximately 30 teachers across the district (a convenience subsample drawn from the 1,000 teachers who used the system), to understand how they attended to the AI-generated analysis of student competencies, reacted to student stories, and shifted the ways in which they spoke about their students and their local theories about how to support them.

Taken together, this paper will shed light on how broader methods and frameworks for equity analytics can create alignment between the design of AI tools from an equity perspective (e.g., attending to power, funds of knowledge etc.), the design of systems and organizational routines toward equity goals (e.g., utilizing RPPs in ways to orient a district toward change efforts at scale), and subsequently raise questions about how to observe the near-term impacts of these efforts (e.g., attending to shifts in teachers' thinking and speaking about their students, as a reflection on their changing models for supporting students).

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