Teacher Advisory Panel: 2020 Technical Report

RESEARCH IN
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EDUCATION

Teacher Advisory Panel: Summer 2020 Technical Report

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Abstract

In this technical report, the Research in Mathematics (RME) team documents the research process and findings from our engagement with the Measuring Early Mathematics Reasoning Skills (MMaRS) Teacher Advisory Panel (TAP) work sessions held in July 2020. These teachers' experiences and perspectives provide important insights for the MMaRS research project, from which researchers will create formative assessments of numeric relational reasoning and spatial reasoning. We followed a Human-Centered Design approach to collaborate with the TAP and qualitative research methods to analyze the resulting data. The RME research team will use the findings from this report—as well as multiple other sources of data—to build the instructional tools and formative assessment items for the MMaRS project.

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Teacher Advisory Panel: Summer 2020 Technical Report

Introduction

The primary goal of the Measuring Early Mathematical Reasoning Skills (MMaRS) project is to create formative assessment resources focused on numeric relational reasoning (NRR) and spatial reasoning (SR) for students in grades K-2. Teachers may use the results of these assessments to guide their instructional decision making to support student learning.

One component of this research project is to engage teachers to serve as a voice for practitioners. To this end, RME researchers worked with the Teacher Advisory Panel (TAP) to solicit their input and guidance from a practitioners' perspective about the use case of the formative assessments, including perspectives about the usability, feasibility, and desirability of the outcomes from these tools.

RME researchers worked with school and district officials in the Dallas-Fort Worth metroplex who recommended a small group of K-2 teachers to serve on the MMaRS Teacher Advisory Panel (TAP). During the 2018-19 school year, eight teachers collaborated with RME researchers to provide feedback about developing assessments that are valuable to teachers in the classroom. RME researchers gleaned important insights from the TAP sessions held in 2018-19, which we built upon through continued, meaningful engagement with the TAP in 2020. The 2020 collaboration with ten new TAP members continued our focus on developing assessment resources that are valuable to teachers making instructional decisions in the classroom.

Research Goals

Drawing from the findings of the 2018-19 TAP technical report and broader purposes of the MMaRS project, we determined two primary goals for the 2020 TAP sessions:

1. **Introduce the learning progressions** to the TAP and study how these tools may best facilitate the use of the NRR and SR formative assessments to inform its design.

2. **Iteratively refine the use case** by building on the findings from the 2018-19 TAP meetings to understand how the TAP would like to use the MMaRS formative assessments and their corresponding learning progressions in their K-2 classrooms.

The first goal—to introduce the learning progressions—is important for the 2020 TAP sessions because they form the context that the NRR and SR formative assessments live within. Teachers need to understand what a learning progression is to be able to use it to support their instructional decisions of "what's next" using the assessment data. RME researchers want to gauge teachers' understanding and reactions to the learning progressions and corresponding skills statements.

The second goal—to iteratively refine the use case—stems from the findings of the 2018-19 TAP sessions and builds on findings from introducing the learning progressions. The purpose of this

continued inquiry was to engage with and learn from the TAP in the assessment design, using learning progressions as the foundation. Drawing from this TAP research, the RME research team will clearly define how the formative assessment should and should not be used (e.g., to support instructional decision-making versus for accountability or as a reporting metric, respectively).

Research Questions

Through engagement with the TAP, the RME team explored the following research questions aligned with goal 1:

1. What are teachers' current understanding of learning progressions?

2. How do teachers envision using learning progressions?

3. What do teachers think about the learning progressions and their usefulness to inform instructional practice with K-2 students?

We also investigated the following research questions and sub-questions aligned with goal 2:

1. How would teachers describe their ideal, classroom-based formative assessment experience drawing from their professional practice?

    a. Who would administer the assessment?

    b. How often would the assessment be administered?

    c. How much time would teachers spend with each student for the assessment?

2. What challenges do teachers face when implementing classroom-based, formative assessments with their students? How do teachers ameliorate these challenges?

3. What type(s) of data do teachers want most from a classroom-based, formative assessment?

4. How do teachers use the data from classroom-based assessments to plan their instruction?

Method

Research Design

RME researchers structured their inquiry with the TAP in 2018-19 within a Human-Centered Design (HCD) methodology. Faculty from the Master of Arts in Design and Innovation (MADI) program at SMU define HCD as a creative approach to problem-solving that designs with the end-user in mind. Drawing from the MADI course description, HCD is a "well-established process and set of methods aimed at devising solutions based on people's needs" (SMU, 2020). HCD is a methodology employed by different groups and fields, and most companies generate

their own process to follow (J. Burnham, personal communication, May 7, 2020). The process taught by co-founders of the MADI program at SMU, Kate Canales and Gray Garmon, is shown in the adapted figure 1.

Figure 1

Human-Centered Design Process
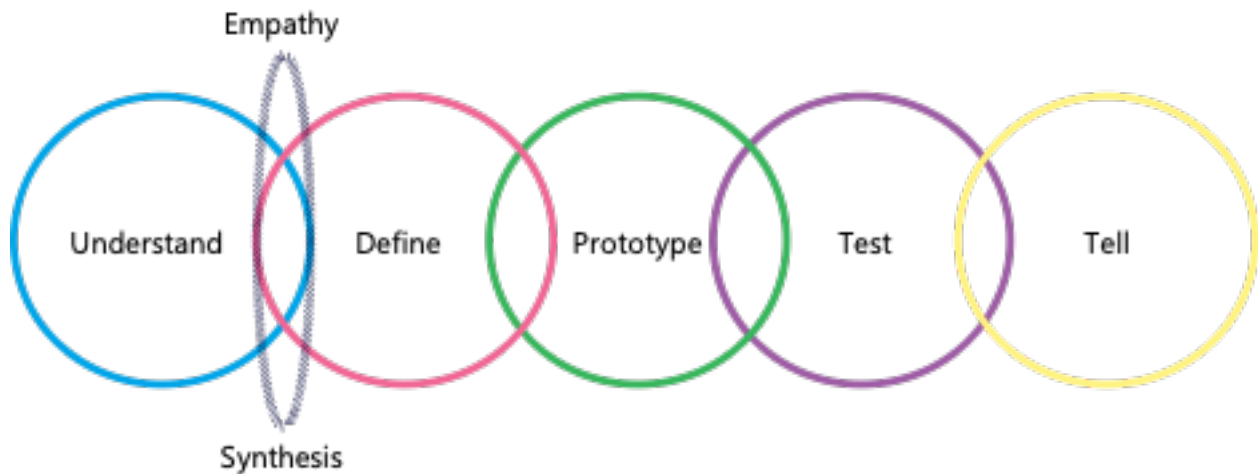
Data collected from the 2018-19 TAP sessions followed the HCD process figure, encompassing components of the understand, empathy, synthesis, and define phases. Drawing from the goals of the study, we continued the research within these spheres of the HCD process, working toward and within the prototype circle with the introduction of the learning progressions and iterative refinement of the use case for the assessment.

Research Team Description

Three members of the RME research team (hereafter referred to as "we") led the early facilitation and design of the 2020 TAP study. Prior to the TAP engagement, two lead researchers facilitated a meeting with six other RME MMaRS team members who had varying degrees of experience with the MMaRS project learning progressions. The purpose of the meeting was twofold. First, we wanted to better understand the research team's perspectives of the learning progressions to help inform the TAP meeting plans. Second, we wanted to practice facilitating two possible HCD activities under consideration for study with the TAP in an online environment. We used Zoom to communicate via video and audio in real-time and Miro as our online collaborative whiteboarding platform.

We facilitated a storyboarding activity to build empathy with the research team and understand more about learning progressions from their perspectives. Under HCD, storyboarding activities may be used to provide a visual narrative that helps build empathy with the end-users of a product. According to Martin and Hanington (2012), this method "can help visually capture the important social, environmental, and technical factors that shape the context of how, where and why people engage with products" (p. 170). The two lead researchers split the RME team into two breakout sessions within Zoom. We asked each team to consider the following questions and

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to draw a three to six panel storyboard of stick figures or images within their designated portion of the Miro board to answer their selection of question(s):

- What are learning progressions?

- How are learning progressions used in our project?

- How are they useful? (For teachers/students/parents/administrators)

- What are the essential ways in which teachers/students should use learning progressions?

- How do Learning progressions play a role in the final outcome of our product?

- How might learning progressions improve K-2 teachers' lives?

The teams decided which questions to answer through their storyboards and selected one or more questions to answer in their drawings—collectively or individually. In the final phase of the process, we ended the breakout sessions and asked each team to verbally share the details of their respective storyboard with the larger group.

During this activity, the lead researchers gathered valuable data from the collective research team about the learning progressions, including gaps and differences in perceptions about their intended use. A snapshot of the Miro board with both storyboards is included in Appendix A. Based on the differences in perceptions among the RME team, we concluded that the TAP might benefit from a more formal introduction to the learning progressions through an existing professional development to establish common language and understandings. Finally, we asked the research team to complete an optional dreams activity individually, at their convenience after the session. The submissions from this assignment inspired the lead researchers' decision to include individual, reflective activities for the TAP in the final research design.

To continue documenting the reflections and theories of the research team, the lead facilitators drafted memos immediately after each meeting session with the TAP. These memos provided supplemental data sources and insight during the analysis phase of the study. According to Miles and Huberman (1994) and Maxwell (2005), this exercise is an essential procedure for qualitative analysis.

Recruitment Process and TAP Participant Selection

The research team recruited TAP participants in the Spring of 2020. We worked with DFW-area district leaders and SMU staff, who nominated 29 K-2 teachers to participate on the TAP for the 2020-21 academic year. We asked nominators to consider teachers currently teaching in grades K-2 with:

- 3-5 years of experience in K-2 mathematics

- A commitment to integrating assessment data to inform instructional design

- Curiosity and enthusiasm for early mathematics and willingness to explore these reasoning concepts

- Interest in developing an ongoing relationship with SMU that integrates research and practice in meaningful ways

Once the nominations list was finalized, we administered an informational survey (shown in Appendix B) via Qualtrics to gather feedback about availability for meetings, years of teaching experience, professional development experiences, and instructional practices to learn more about the TAP nominees and make our final selections. We included three timeslots to choose from on each of the 12 dates—two during the day and another in the early evening hours—so that participants had 18 options for meeting session 1 and 18 options for meeting session 2.

We purposefully selected 12 participants with an equal distribution of kindergarten, 1st, and 2nd-grade teachers across school and district types with common availability for the two meeting sessions. The ideal size for focus groups is generally between five to eight participants, depending on the subject matter and extent of the participants' expertise about the research topic (Krueger and Casey, 2009). We planned to split the TAP into two smaller groups to allow an optimal opportunity for all participants to share their responses to the questions.

Ultimately, the research team recruited and convened ten TAP participants who work across nine public and private schools in seven districts in the DFW metroplex. These teachers also reported using a variety of instructional models, including small group instruction, whole group classroom routines such as calendar math and number talks, math workshops, and whole group instruction. A summary of the demographic details about the 2020 TAP participants is shown in Table 1.

Table 1.
TAP Demographics

	School Type	District Size & Locale	Grade Level	Years of Experience	Age	Level of Education	Minutes of Math Instruction per day
1.	Private	Large City	K	4	20-29	BA	60
2.	Public	Large Suburb	K	14	30-39	BA	90
3.	Public	Large City	K	7	30-39	EdM	40
4.	Private	Large City	1st	20	50-59	BA	70
5.	Public	Large Suburb	1st	12	40-49	MA	90
6.	Public	Rural Fringe	1st	6	20-29	MEd	90
7	Public	Large City	2nd	10	30-39	MA	90
8.	Public	Large City	2nd	4	20-29	BA	100
9.	Public	Large Suburb	2nd	13	30-39	BA	90
10.	Public	Large Suburb	2nd	20	40-49	BA	90

Data Collection

Based on the two primary goals of the 2020 meetings, we continued engagement and study with the TAP within the HCD framework. We met twice and used several activities across the two

sessions that spanned one to two hours for each meeting. We also assigned work for the TAP to complete before the first meeting session and collected individual reflections from the TAP after the second meeting session. After the two meetings, we had the following data sources:

- Individual pre-work data from all ten TAP participants

- Two transcripts from the focus group discussions—one for each group

- Three transcripts from the design charette activity—one for each of the 3 groups, including the whole group discussion after the design charette activity

- Miro whiteboard notes from the design charette activity

- Individual reflections on drivers and preventers from nine of the 10 TAP participants.

Meeting 1 Activities

The first goal of the 2020 TAP sessions was to introduce the concept of learning progressions to the TAP. Drawing from the research team's pre-study experiences, we did this through an existing online professional development course offered by the Texas Education Agency (TEA). TAP participants watched an adapted version of the TEA course as an entrée to learning progressions. They completed an accompanying learning portfolio document that included questions and activities that were aligned to the content of each module in the professional development course. See Appendix C for more detail about the instructions for the TAP to complete the professional development sessions and accompanying learning portfolio pre-work.

The purpose of using the learning progressions is to support instructional decision-making. The pre-work provided TAP participants with a common language and understanding of learning progressions. We conducted a focus group discussion with the TAP after participants completed the online professional development session and learning portfolio with these purposes in mind.

All ten TAP participants joined the first meeting session via Zoom, a virtual meeting platform with audio, video, and screen sharing capabilities. RME researchers provided introductory remarks and then split the group into two breakout rooms with two RME facilitators and five TAP participants in each room. A copy of the semi-structured questions that we posed and discussed during the focus group session with the TAP is included in Appendix D. Each question is mapped back to the research questions for goal 1 in brackets. The focus group discussions were recorded and transcribed for later analysis.

Engaging with the TAP on this topic helped us study how the learning progressions may best facilitate the use of the NRR and SR formative assessments to guide instructional practice and decisions. And given that the learning progressions form the context that the NRR and SR formative assessments live within, studying teachers' understanding and reactions to learning progressions are important steps toward the prototype phase within the HCD process. Using the TAP sessions to learn more about teachers' perceptions and understanding enables us to help teachers better utilize the learning progressions and corresponding subcomponent statements in the future.

Meeting 2 Activities

The second goal of the 2020 TAP sessions was to continue to refine the use case iteratively. Specific HCD methods included the following two activities to home in on the uses of the classroom-based, formative assessment and collaborate with the TAP during the early prototyping phase of the design. These activities were carried out in a second TAP meeting. Similar to the focus group protocol, we listed the two research questions to which each of these activities is aligned in brackets:

- **Design Charette** is "a workshop-style technique that provides a collaborative space that allows for [the] creation and cross-pollination of design ideas to occur. Designers and non-designers—including project stakeholders, engineers, and users—can participate in a design charette" (Martin & Hanington, 2012, p. 58). [Goal 2: Research questions 1, 2, 3, and 4]

- **Drivers and Preventers Activity** is a reflective activity that we asked the TAP to complete individually during the final group discussion. It is loosely based on the importance-difficulty matrix technique outlined by Hanington and Martin (2019), where users prioritize "design ideas or features based on how critical they are and how expensive or challenging they are to implement" (p. 136). [Goal 2: Research questions 1, 2, and 3]

Group design charettes

Drawing from Martin and Hanington (2012), the RME facilitators assigned the TAP to three groups of three to four participants, plus one RME moderator and one RME technical assistant. Each team—silver, red, or blue—worked together to design responses to the prompts about their ideal testing scenario, based on their own classroom experiences with assessments. The leading prompt during round one was as follows:

> Drawing from your professional practice, how would you describe your ideal, classroom-based formative assessment experience? Why?

The TAP participants were instructed to draw/sketch, use icons, or use post-it notes with narrative within their space on a Miro board. This virtual whiteboard allowed participants to collaborate online in real-time. RME facilitators posed additional verbal prompts within their assigned groups, including the following:
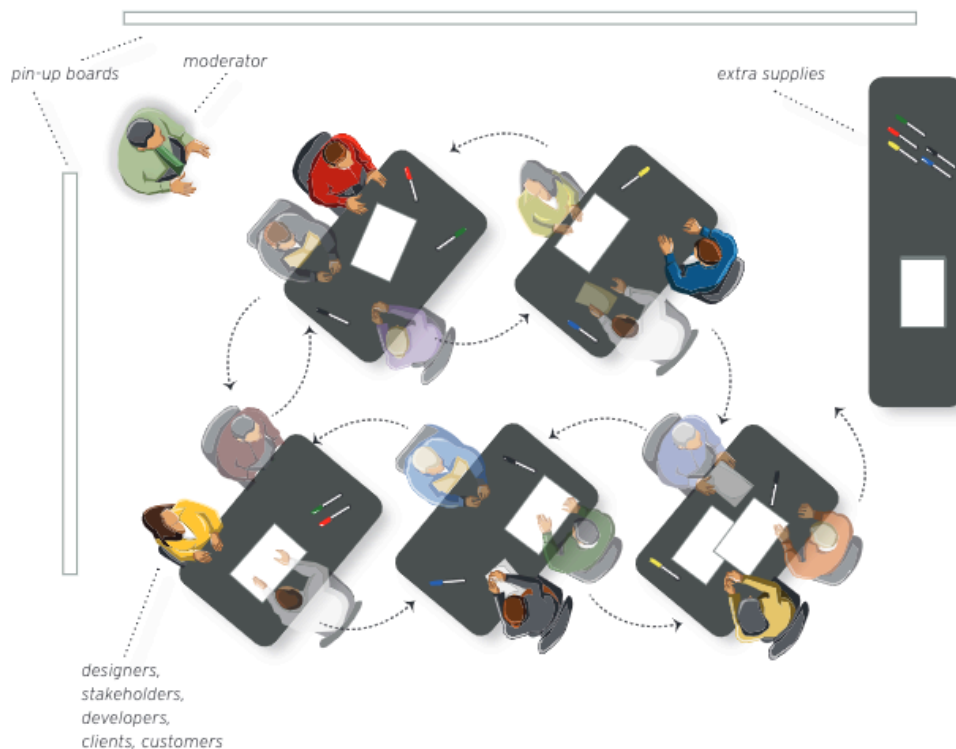
- Who would administer the assessment?

- How often would the assessment be administered?

- How much time would teachers spend with each student for the assessment?

- What challenges might you face with this experience? How might you ameliorate these challenges or pressures?

- What types of data would be generated from this assessment?

All participants were encouraged to share their ideas as freely and imaginatively as possible. After 20 minutes, two to three TAP members from each group rotated to a new group. This rotation repeated twice after the first session, totaling three sessions of 20 minutes each. A visual depiction of the movement between groups that meet in-person for a design charette is illustrated in Figure 2.

Figure 2

Design Charette Movement Between Groups

pin-up boards

moderator

extra supplies

designers,
stakeholders,
developers,
clients, customers

Source: Martin and Hanington (2012), p. 59

Participants talked with each other to compare and contrast their responses at each round or iteration to facilitate the process. This design builds on the momentum of groupthink across all the TAP participants. Participants shared their favorite idea(s) as they moved to each group, and we found the "cross-pollination of the best ideas begin to emerge and inform superior design concepts" (Martin & Hanington, 2012, p. 59).

Individual drivers and preventers

The final 45 minutes of the session were reserved for the individual groups to reconvene in the main session and share their ideas with the whole group. This evaluation and synthesis of ideas should happen concurrently—rather than in the small group design charettes—and moved the

team to the early prototyping phase of HCD. After each of the three group leaders shared their Miro board with the group and discussed their collective responses to the design challenge, the RME facilitator provided two minutes of silent time for the TAP to reflect.

During this time, we asked the participants to individually record the "drivers" and "preventers" from each group's presented Miro board work. More specifically, the drivers are any ideas or concepts from the description of the assessment experience that would help the teacher be successful in making instructional decisions. Some participants labeled this column with a plus (+) sign. The preventers are any ideas or concepts from the group's description that might hinder the teacher's ability to make instructional decisions. Some participants labeled this column with a minus (-) sign. TAP participants typed their responses or took a picture of their handwritten responses and emailed them to the RME meeting facilitator. This individual reflective activity was purposeful and enabled the TAP to share their thoughts with the research team that may or may not conform to the group's perceptions and offered another data source for triangulation.

Analysis

Each TAP session was digitally recorded using the Zoom record feature by multiple RME researchers for backup coverage. These recordings included the main session as well as the separate breakout rooms where smaller groups of TAP members participated in the focus group and the design charette activities. RME researchers sent the recorded audio files to a third-party vendor (Rev.com) for transcription. Upon receipt and review, we loaded all the transcripts, learning portfolio pre-work submissions from the TAP, Miro whiteboard notes from the design charette activity, and the individual reflections on drivers and preventers from the TAP participants into a shared NVivo project file. NVivo is a software program used to organize and facilitate coding and analysis of data—especially in qualitative studies—on research teams.

Analytic Strategies for Meeting 1 Data

Two coders reviewed the transcript files from the first meeting session focus groups' discussions as well as the learning portfolio submissions—the TAP pre-work from the professional development session on learning progressions. We conducted this review independently and noted key words and concepts from the data files as preliminary ideas for organizational categories and possible substantive categories (Maxwell, 2005). One of the coders created parent nodes within the NVivo project file that captured these organizational categories and coded the transcript data within these parent node categories. The second coder analyzed the transcript files and learning portfolio submissions and drafted analysis notes in a word file.

The two coders met to discuss and compare their preliminary organizational coding schemes for the meeting 1 data. Maxwell (2005) writes, "organizational categories are broad areas or issues that you establish prior to your interviews or observations, or that could usually have been anticipated" (p. 97). The researchers had already mapped the focus group questions back to the study research questions (as shown in brackets in appendix C), so it was not surprising that the organizational categorization aligned with this mapping.

The organizational categorization process is similar to a priori coding. However, Creswell (2013) cautions that the use of a priori codes "does serve to limit the analysis to the 'prefigured' codes rather than opening up the codes to reflect the view of participants in a traditional qualitative way. If a 'prefigured' coding scheme is used in analysis, I typically encourage the researchers to be open to additional codes emerging during the analysis" (p. 185). Following the Creswell (2013) method and the Maxwell (2005) substantive categorization process, one coder modified and expanded the coding structure by open coding the transcript, learning portfolio, and memo data from the meeting 1 session that fell within and outside the initial organizational categorization. The second coder reviewed the second round of coding and provided critique and feedback about the expanded and substantive categorizations.

## Analytic Strategies for Meeting 2 Data

Two coders—one from the meeting 1 coding team and a different lead researcher—worked together on the analysis of the meeting session 2 data. The HCD activities planned for the second meeting were comparatively more iterative than the focus group interview protocol. Although the activities were closely linked to the research goal 2 and the research questions, researchers did not develop a priori codes for the meeting 2 data. Similar to the meeting 1 analysis, the two coders reviewed the interview transcripts, Miro whiteboard data, and the drivers and preventers submissions separately. Coders analyzed these data, noting commonalities between and across data sources and noted possible organizational categories (Maxwell, 2005). Upon completion of this first step of independent analysis, the two coders met to discuss the initial coding structure. Moving toward the substantive and theoretical categorization phase (Maxwell, 2005), one of the coders developed a concept map, depicted in figure 3, as part of the meeting 2 data analysis.

These visual, sense-making tools are common strategies in qualitative research. Miles and Huberman (1994) write about conceptual frameworks, and Strauss (1987) writes about integrative diagrams, although there are differences in how these various strategies are used. Maxwell (2005) notes several reasons for creating concept maps, including to "…develop theory. Like memos, concept maps are a way of 'thinking on paper'; they can help you see unexpected connections, or identify holes or contradictions in your theory and help you figure out ways to resolve these" (p. 47).

The two coders used the concept map to draft high-level parent nodes and child nodes. Then one coder used this framework to code the transcript data, Miro boards, drivers and preventers submissions, and the researchers' memos. Additional child nodes emerged, and revisions were made to the parent nodes during the open coding process. The second coder reviewed the first coder's NVivo files, and the two coders met to discuss and refine the structure and discuss the themes from these data.

Figure 3

Concept Map for TAP Meeting 2 Data
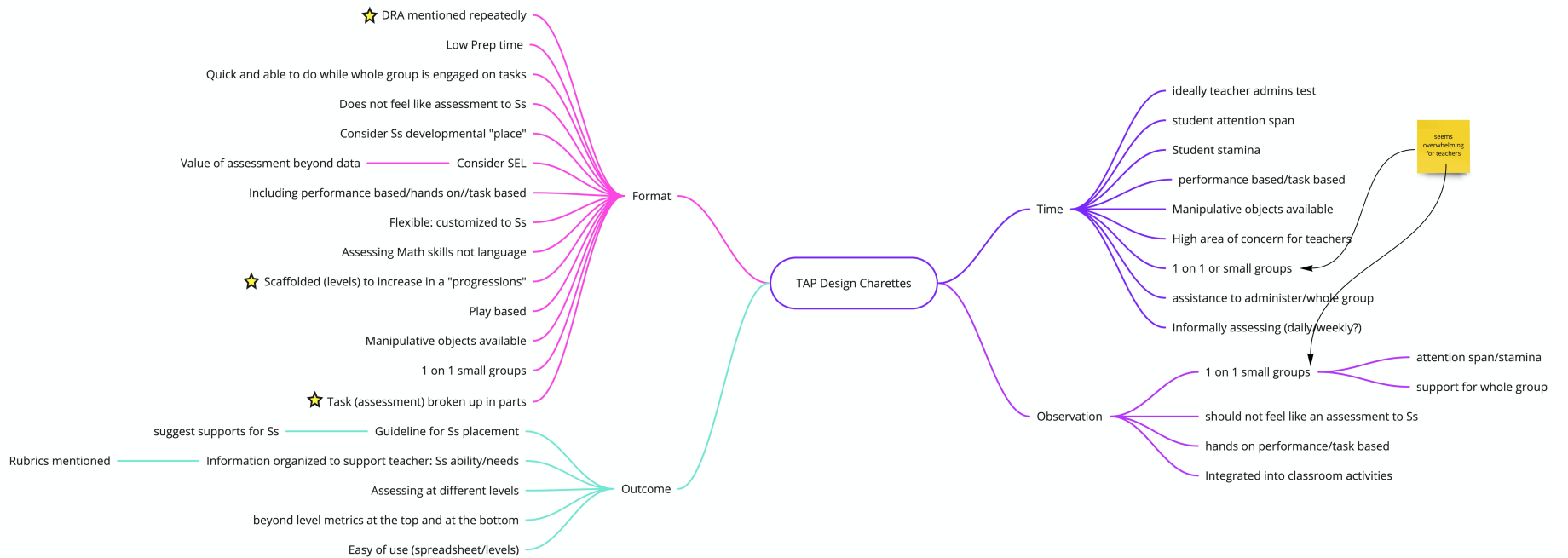
Integration of Data Sources

The common coder across the two meeting sessions reviewed all the data sources, including the other two coders' analysis notes, to consider themes and coding structures across the multiple sources. The three researchers used the data, as coded in the shared NVivo file, to develop substantive categorizations across data sources and write the findings for this technical report. Maxwell (2005) explains substantive categories "are primarily descriptive, in a broad sense that includes a description of participants' concepts and beliefs; they stay close to the data categorized, and don't inherently imply a more abstract theory" (p. 97). Corbin and Strauss (2015) note that substantive categories may be inductively developed through open coding. The final codebooks for the meeting 1 and meeting 2 data, including the parent nodes (organizational categories) and child nodes (substantive categories which are often subcategories of organizational ones), are included in Appendix E.

Methodological Integrity

It is important to reiterate that the data sources analyzed for this study included the audio transcripts from the focus group and design charette activities, individual reflections from the TAP members' pre-work on learning progressions, and drivers and preventers submissions, as well as memos and concept maps from the RME researchers who designed and facilitated the meeting sessions. These varied data sources allowed the team to triangulate and review the themes across multiple sources of evidence. The research team also accounted for reflexivity through the following processes:

- piloting some of the HCD activities prior to the TAP meetings and incorporating outcomes from this pilot in the study design

- writing memos throughout the data collection and analysis process

- consensus and auditing processes completed by the researchers during coding.

One researcher also piloted the semi-structured interview questions with an elementary school gifted and talented teacher in advance of the TAP focus group meeting.

Member checks (Lincoln and Guba, 1985) were not formally conducted with the TAP after data collection, however, the Miro board and whole group sharing activity during the last portion of the second meeting session enabled participants to hear and visually review the collective summary of each group's design charette. Meeting facilitators encouraged the TAP participants to clarify or add to these verbal summaries and the shared Miro whiteboard. Participants were also given the opportunity to contribute their thoughts anonymously, via the drivers and preventers submission.

To encourage frank responses and preserve anonymity, the RME researchers promised the TAP participants that they and their schools and districts would not be named in our reporting. We also asked the TAP participants to refrain from discussing the content shared by their peers outside of the meeting sessions. As cautioned by Glesne (2006), research participants have a

right to expect that you will "protect their [participants'] confidences and preserve their anonymity" when they grant permission for interviews (p. 138).

Findings

The TAP participants offered a variety of perspectives from K-2 classrooms in both public and private schools. Two of the teachers had four years of teaching experience, one participant had seven years, and the remaining seven TAP had more than a decade of teaching experience, with two of these teachers finishing their 20th year in the spring of 2020. Five of the participants taught in large cities, four in large suburbs, and one in a rural school at the time of data collection. All ten of the TAP participants shared a variety of formal and informal classroom-based assessment experiences with young learners. Even with this mix of teaching contexts, the findings from the TAP meeting sessions coalesced into common themes under the topics of learning progressions and assessments, as the study was designed. Common themes were broken into the following four categories:

1. Learning progressions

2. Ideal assessments

3. Assessment Challenges

4. Use of assessments

The research questions related to the categories and the findings within subcategories are detailed below.

Learning Progressions

The RME team examined the following research questions from the data collected before and during the first meeting session with the TAP:

1. What are teachers' current understanding of learning progressions?

2. How do teachers envision using learning progressions?

3. What do teachers think about the learning progressions and their usefulness to inform instructional practice with K-2 students?

Overall, the TAP responded positively to the concept of learning progressions and their potential usefulness to inform their instructional practice.

TAP understandings of learning progressions

As outlined earlier, teachers engaged in an online professional development module as introduction to Learning Progressions and completed a learning portfolio as they worked through the module. The coding team analyzed responses teachers provided on their pre-work to look for trends of emerging and evolving understandings of learning progressions. Based on their written responses and conversation in focus groups, we found that understandings evolved from teachers' pre-understandings to more formalized comprehension.

In their pre-work, teachers began by freely sharing their past knowledge and experience with learning progressions. Responses ranged from admittance of no past knowledge and inferences that learning progressions are "the progress a student will demonstrate." There were some early misconceptions, including that learning progressions are how teachers design lessons, including ordering, timing, and student learning outcomes based on developmental appropriateness. This represented how a teacher might use a learning progression to guide their teaching, not what a learning progression actually is. At this stage, teachers generally described the desire to create lessons as learning progressions, which represents best practices of educational pedagogy, not learning progressions as a function of student learning. Their view on learning progressions was generally focused on their teaching practices. However, one participant expressed a deeper understanding by the end of the module:

> I notice that the graphic represents the Learning Progressions as an established path. The concepts in number 1 are the beginning point where the students begin to learn. However, it is not strictly followed as not all the students follow the same path at the same time. Some students need to learn three concepts to understand 1 topic, others will need only one. Students can learn the topics in different orders according to the depth of their understanding of the concepts.

A general softening was felt during the focus group as teachers talked among themselves and built off of one another's ideas. This social construction of deeper understandings about learning progressions led to some inferences about the utility of learning progressions in the classroom and the idea that these are tools teachers can use to facilitate student learning. One participant shared the noticing that learning progressions are different from standards, and that they could serve as a backward path to fill in the gaps in students' learning. Another added on that learning progressions would guide them to meet children where they are at rather than fitting their current performance and knowledge into the standards.

Learning progressions as a tool

During the focus group, facilitators asked participants to think creatively about learning progressions by relating them to tools. Teacher's responses indicated deep thought about the utility of LPs. Their tool metaphors indicated that teachers saw LPs as means to physically structure teaching and learning, measure progress and adjust for skill acquisition, or ways in which to view combinations of knowledge and skills that lead to productive student outcomes.

For those relating LPs with physical tools, one teacher shared their vision of the LP as a saw because saws break wood apart and an LP does the same with a skill; the cut-apart progression

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can be used step by step to build students' knowledge and skills, while correcting student errors and misconceptions in the process. More directly, a teacher related the LP to a hammer with knowledge as nails. Just as nails do not automatically go into wood, knowledge also needs a direct to be absorbed into children's understandings. The LP as the hammer drives the required knowledge and skills. Socket wrenches were also mentioned because they are adjustable to one's needs. When a child student's current level of understanding is misaligned with the designated skill, the LP guides teachers in adjusting instruction to a better fitting skill that a child might have missed in their initial learning.

Relating the LP to less active tools, one participant from each group compared LPs to a measuring tape. One noted the evenly marked spacing could be used as a scale, or continuum, of skill level upon which teachers might locate student performance. The other envisioned it as a way to measure progress. Another teacher described the LP as a level to "balance things out", noting that teachers "might have to tilt it this way, or tilt it that way," to best facilitate student learning. A ladder was also named as an LP metaphor, because moving up and down to provide students what they need as they progress toward sophisticated thinking is possible on a ladder. These individuals focused on adjusting teaching to meet students at their current level so that learning aimed toward a given standard or skill.

The most prominent tool named was a recipe or instruction manual. We found that teachers have an arsenal of tools that they are continuously adding to and adapting to meet the needs of the students who come into their classrooms. Using a recipe allows for substitutions, so when a child is missing an "ingredient", or background knowledge, the teacher finds a way to get them to the final product. This idea was echoed with a road map that could be used for the general directions to get children where they need to go in the learning. These teachers understood the adaptability that learning progressions allow while also knowing that despite potentially non-linear progression, children should arrive at the end-point successfully through proper LP implementation. A visual depiction of this is shown in Figure 4 from the TEA professional development module.
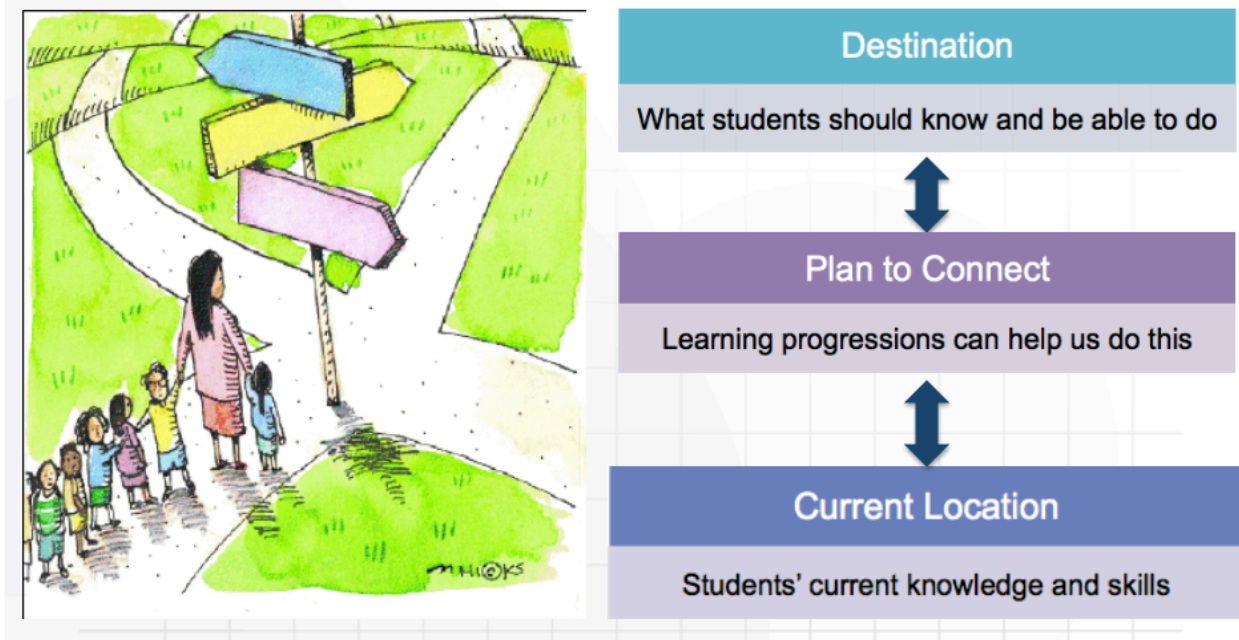
Use of learning progressions

Building on the analogy of learning progressions as a tool, all of the TAP participants shared thoughts about how they might use learning progressions to do the following:

- understand their students' progress and needs

- plan their instruction

- inform the grouping of their students

- and even communicate with parents.

- During the initial analysis phase, we coded this concept as "learning progression utility" and defined the theme as how teachers perceive learning progressions as being useful, either for instruction, assessment, or otherwise. As shown in the focus group protocol, we

directly asked the TAP "Based on your current understanding, how might you use learning progressions?"

Figure 4.

Why Study Learning Progressions from the TEA

Source: Texas Education Agency (n.d.). TEA ESTAR/MSTAR Learning Progressions. Retrieved from
http://jukebox.esc13.net/learningprogressions/HTML_materials/lp_03_06_reflection_slides.pdf

Several TAP members said LPs may help them gage their students understanding, including gaps or misconceptions, as well as those who may need more challenging content. One teacher's comment illustrated this sentiment and pointed to using LPs to form small groups:

> I know that we use assessment to drive our instruction at my campus, but the problem with most assessments: there's a floor and there's a ceiling. And what I like about the learning progressions is that you can take a concept like place value and if you have a student who is struggling you can work it backwards and kind of find where the holes or the gaps in their learning are. Maybe take them back to just understanding a base ten number system. But if you have a child who's flying through it you can look ahead and get them started on regrouping and things like that. And so I like that there's not really a floor or a ceiling. You can kind of move students ahead or back up and try and fill in some of the gaps in their understanding and I think it would be really great for differentiation and creating those small groups in your classroom.

TAP participants noted the potential for using LPs to help plan their content and lessons after ascertaining students' current levels of knowledge and skill. This would ensure that teachers

have practice activities available for students to engage in and build upon skills they may have already mastered. The flexible student groupings may also inform what activities the TAP plans for guided instruction via small group.

Other teachers noted the LP concept and terminology may help them work collaboratively with fellow teachers during their Professional Learning Community (PLC) meetings to discuss where students are, where they need to go, and provide a guidebook on how to get there. One teacher recognized that even though the state standards and the school's scope and sequence documents are available, the LPs may provide teachers better insights into an individual student's understanding. For example, two students may demonstrate that they can look at an arrangement and count up to ten, but the two students arrive at that result in different ways. The LP can help teachers understand those different pathways.

Teachers also noted other stakeholders may find using an LP helpful. One TAP member replied

> "I think that this [LP] is a great tool for parents also to understand how their children can improve. So this is also a teaching tool that we can use but I think it's easily transferable for parents to understand where their children are and where we want their children to be…it could be used within a parent conference to intervene or to provide support for what we're seeing in the classroom that is a little bit more targeted and a little bit more exacting…"

Two other TAP participants agreed that learning progressions may be a useful tool to reference during parent conferences.

Several TAP members also wrote about specific uses of LPs in their learning portfolio submissions from the TEA professional development session. For example, one teacher wrote:

> "Teachers should continuously develop a sequence of instruction for whole group instruction and small group intervention. Learning progressions improve instruction by helping to sequence content with the end in mind, connecting current content to previous content, correcting misconceptions and errors as they arise."

Another teacher wrote that the LP is like a path that students walk along and understanding LPs helps the teacher to see the students' way of thinking, know where the students are, and guide them through the pathway to learn the concepts. Other TAP acknowledged that it is helpful to think about student learning as a pathway with many different options for achieving the same end goal through the LP concept. And when "we understand the path, we can offer explanations and activities based on them and give students a safe place to really learn these topics." Finally, one teacher wrote about the use of LPs and made important connections and distinctions between standards, LP, and assessments:

> "A standard is an overview of what every student should learn. Learning progressions allows for teachers to put students at the center of the educational

experience.…Assessments along the progression help us learn where students are and how teachers can help move them forward."

Systemic Challenges and Recommendations

All of the TAP members emphasized the potential value of LPs, yet some also noted tight timelines, scope and sequence protocols, and rigorous standards as potential pressure points for teachers using the LPs. One teacher explained that "I feel like it's really hard when sometimes you know what the end goal is and there's such rigor and there's such a strict timeline to get there…so how do I honor the learning progression?"

Nevertheless, most of the TAP participants did not have any changes to recommend related to the LP concept. Instead, one participant commented that the "hive map" for the LP used in the professional development module was difficult to follow. Another TAP said the hexagons of the LP graphic and the standard number with arrows were "really helpful." And a few participants noted during the focus group and in their learning portfolio submissions that they would have appreciated contextual examples from K-2 math classrooms. (The examples used in the TEA professional development module was specific to math concepts for higher grade levels.)

Comfort with learning progressions

In general, the TAP members were excited about LPs and their potential value. When we asked participants about their comfort level in leading a professional development workshop about LPs with their peers, several noted there may be some initial angst among teachers in their district, however, the concept of LPs and individualizing instruction for students is something "that we've all done in some way." As long as teachers have the resources to teach LP as a tool with a strong research base, rather than "another new thing," it could be successful. One teacher explained:

> "I'm a little hesitant to answer. Just picturing presenting it to my staff, I feel like we get a new program or a new system every single year, and you start to lose buy-in, just because so many of them seem similar. But I'm usually one that's pretty skeptical on things like that and when I saw learning progressions, it didn't seem overwhelming or threatening because it's something, you know, as a teacher, if you've taught for a while, you start to sort of think of learning in this way and so I feel like I would be a little nervous but I would definitely just pitch it in a way where you're just doing what you've always been doing you just have a more outlined map for it. So, I do think it's a great tool and people would get excited. But anytime there's another program, I feel like people start to check out, so that may be my only hesitation, but I think this is really meaningful and something that good teachers think about anyways …."

Drawing from the narrative in the RME researcher memos, we were somewhat surprised by the value and buy-in about learning progressions expressed by the TAP participants—both during the focus group discussions and in the data from their learning portfolio submissions. Building on the momentum from the TAP excitement, RME researchers focused the second session on designing formative assessment resources and understanding the TAP's ideal use of these tools.

Ideal Assessments

As noted earlier, the learning progressions form the basis upon which the MMaRS formative assessments are built. Having established a foundation with the TAP about LPs during the first session, we focused the second TAP meeting on refining the use case for the MMaRS formative assessments through design charette group and individual reflection activities. The first research question and sub questions, which informed the HCD method, focused on teachers ideal, classroom-based formative assessment experiences:

1. How would teachers describe their ideal, classroom-based formative assessment experience drawing from their professional practice?

    a. Who would administer the assessment?

    b. How often would the assessment be administered?

    c. How much time would teachers spend with each student for the assessment?

Findings on ideal assessments centered around format, administration, existing assessments, and time.

Assessment Format

During the design charette discussions, several TAP participants emphasized the importance of flexible assessments with some element of hands-on or performance-based task. One teacher stated the need for diverse test item types, specifically for lower grades. Teachers said their ideal assessment experience would be developmentally appropriate and aligned to students' level of understanding for particular concepts: "Ideally, you want something that is differentiated and that meets students where they're at so that you can learn more about them. And you're not just giving one blanket assessment that you might not fit for everybody."

Some teachers noted the ideal formative assessment would not have a "floor or a ceiling." For example,

> "I know that I've had students come into my classroom and get a 0% on an assessment. And that doesn't really give me any new information about them. Same thing as if they get a 100% on an assessment. If you get a zero or a 100, you don't know where your student is at and where their learning stops or begins. And so it would just be really important that for this math assessment or whatever you're doing, that there's not a floor or a ceiling, so that you're able to get an accurate picture."

Teachers said that their ideal assessment would be flexible and students would have the option to use manipulatives, if appropriate. Several teachers noted the importance of mixing formal and informal assessment practices within the format so that it "doesn't feel like as assessment," especially for the younger K-2 students. One teacher wrote in her drivers and preventers

submission that the ideal formative assessment would be most useful if "tasks could be broken up… not everything needs to be assessed at once and every time."

Some teachers suggested incorporating technology within the assessment format, as long as teachers could still "see" the student's cognitive process—not just the outcome of the formative assessment. This might be accomplished through video and audio recording of students completing tasks for teacher review. Another noted that technology may help to "streamline the assessment process" to both collect information from the students and synthesize results for the teachers. Ideas about technology and other formatting suggestions from the TAP's Miro whiteboard are displayed in Figure 5.

Figure 5

TAP Ideas on the Ideal Assessment Format
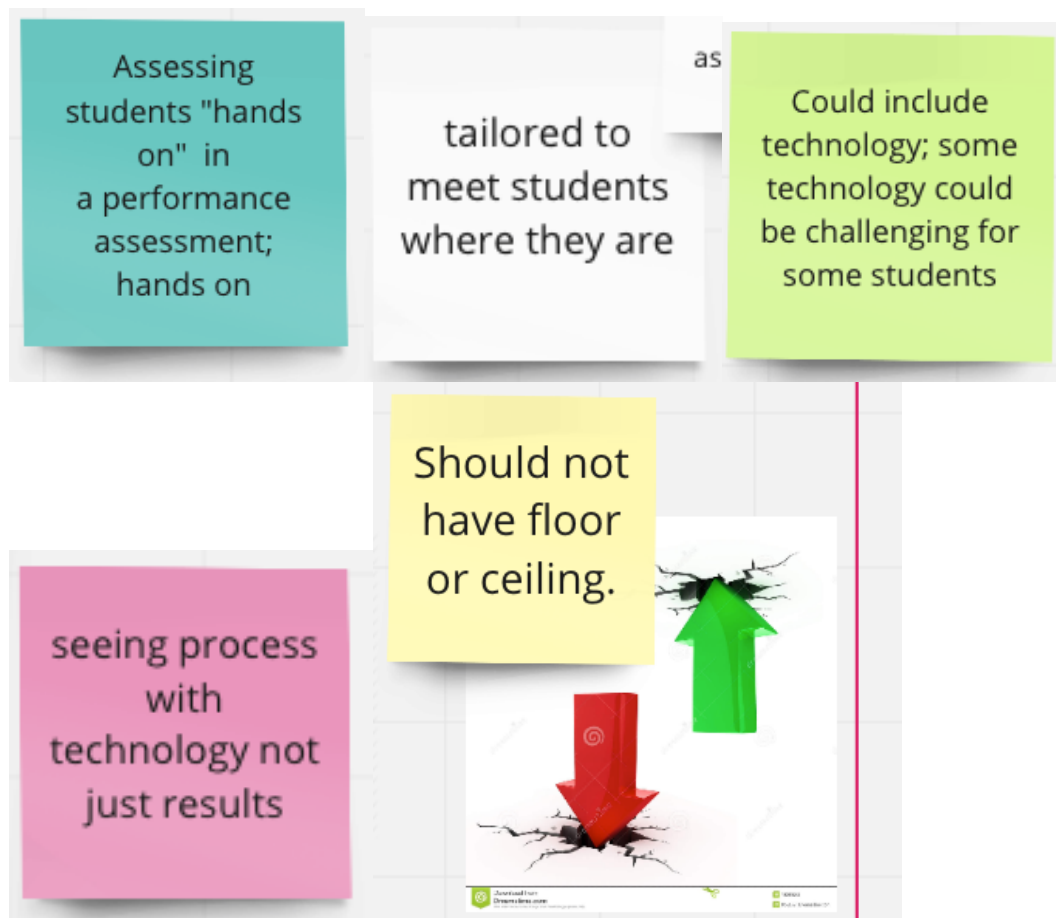
Administration

Many of the teachers emphasized that the ideal formative assessments would be administered either one-on-one or in small groups of students by the lead teacher. The TAP explained it is important for them, as lead teachers, to see and understand their students' process. One teacher

summarized her group's discussion and shared "we feel like it's best done in either a small group or a one-on-one setting, depending on the age, just so you're up close and watching the students take the assessment and you're able to really monitor their thinking as they go." Another teacher commented "We talk about learning hands-on, but also assessing students hands-on. So for me, an ideal format of assessment today would be that performance-based in a small group setting."

Within the drivers and preventers data, some teachers noted the importance of providing accommodations within their ideal assessment for students who may need them. Along this same vein, all three of the design charette groups discussed equitable language and ensuring that the format of the assessments enables their students to show what they know. One teacher explained:

> "…there is comprehension in math but trying to find that balance of what's the challenge and what am I assessing for this kid? Can he just show me…2+4 instead of understanding the word problem that has 2+4…and so that's a challenge that I've run into with not just ESL students… and trying to make sure I am assessing them in a way that is showing what they do know because they might not know it in this format but can I do it a different way?"

Other teachers echoed these sentiments and commented that their ideal assessment would be conscientious of language, especially homophones such as "eight" versus "ate," to ensure valid results for all their students.

Example Assessments

In both the TAP sessions, teachers highlighted characteristics of the existing informal and formal assessments that they use and find valuable in their K-2 classrooms. For example, a few teachers reported they do "clipboard cruising" to gather informal data about their students as they are immersed in their learning environment—whether it be working independently or in a small group. For this type of informal assessment, teachers jot down general observations about their students by name, date, and time, including the observed behavior and the center or task that the student was working on (Gregory & Chapman, 2013). Teachers said they like assessing in this manner because it can be completed quickly and easy to use for instructional planning and later documentation, if needed.

Teachers also pointed to small- and whole-group games that they use as informal assessments. One teacher elaborated:

> "…so a lot of times we'll play games in small groups…and I'm not looking at what everybody's doing all at once. It's just those kids sitting in my small group and even though they're playing a game, I can watch their problem-solving skills or I can go through and understand what exactly it is they are missing or unsure of."

Another teacher continued:

> "We do a lot of whole group games as well, and then just sitting with different kids throughout it or walking around and I always have my clipboard or notes with me and that way I can jot down a quick note or two and say okay, I want to

make sure I check in with his kiddo later during our small group, because I noticed something earlier on.... Just keeping things fun and light, but also always keeping my notes nearby so that I can say, 'Oh, I need to make sure that I work with this kid today on this exact topic.'"

Teachers repeatedly referenced using—and liking—the formal Developmental Reading Assessment (DRA) with their students to assess and monitor literacy skills. According to Beaver and Carter, the DRA helps teachers to determine "student's independent or instructional reading level with an evaluation of three components of reading: reading engagement, oral reading fluency, and comprehension" (2019, online). The TAP participants noted several reasons they felt that a math assessment that mirrored the DRA might be ideal. For example, the DRA is differentiated and teachers commented it would be great if they had a differentiated assessment instead of a "one size fits all" for math. One teacher provided more detailed insight about this association:

"It seems like everybody follows this kind of pattern for reading and it's so differentiated. It's easy to understand and see their thought process because you're doing it with them, you're listening and it kind of has all the components you need for a good assessment. And then you get to math and it's not that, or you don't have something like that. And so then it would be really great to have something where you can say, okay, I know that they're at about this level. So I'm going to pull this assessment because that's what is probably going to work for them. You'd be able to see their thought process, gain the data that you need and then for the next student, you could pull a different one. That would be really great."

The teachers noted using assessment results to form groups and make instructional decisions based on gaps in student knowledge. A few teachers made connections between using the DRA results to understand their students' knowledge within and along a learning progression.

The TAP participants highlighted parallels between their ideal assessment experiences and existing instructional and intervention tools, such as reading running records, the Leveled Literacy Intervention from Fountas and Pinnell Literacy, and the Go Math! program. The ideal commonalities across these tools for teachers were differentiation and grouping as well as understanding, monitoring and sharing students' progress with fellow teachers and parents. Teachers also noted that each has accompanying instructional materials and resources that are aligned with the curriculum.
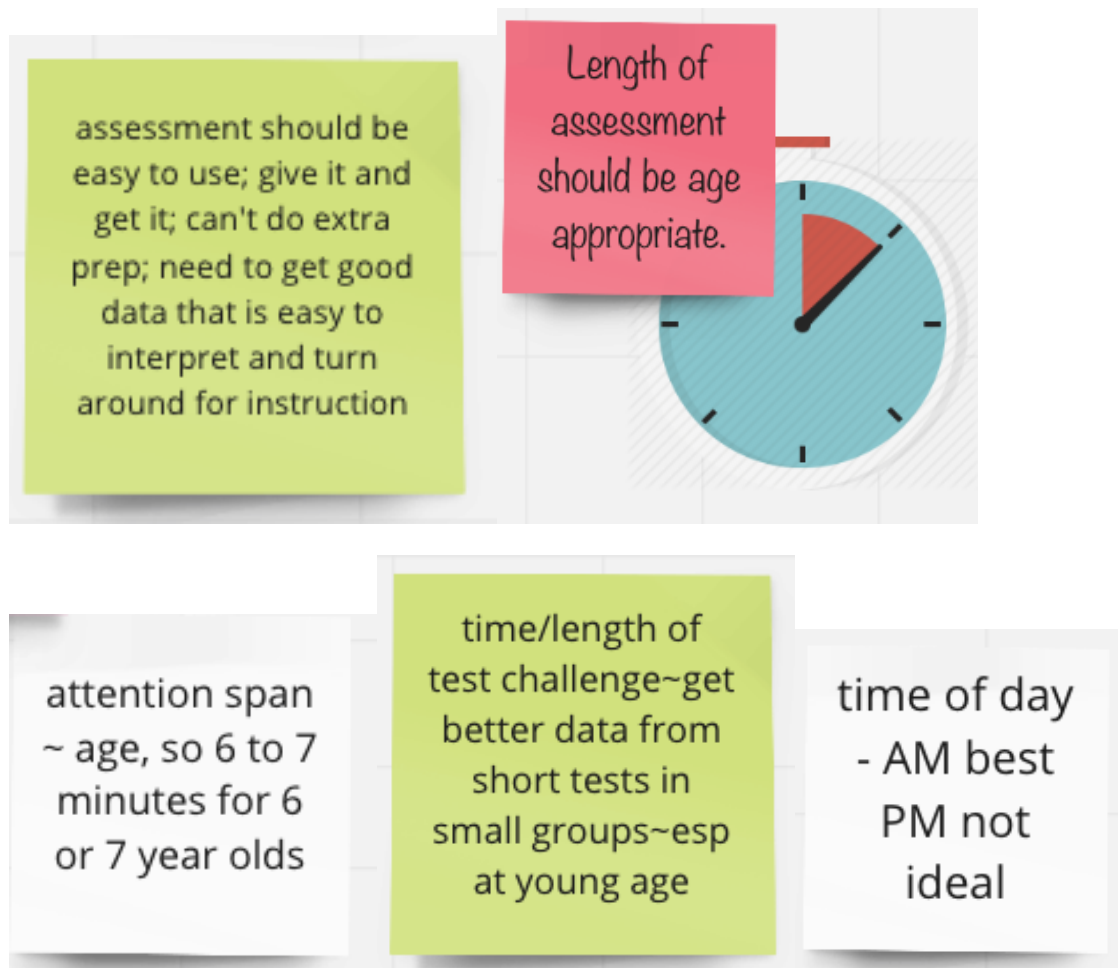
Time

A common theme across all of the data sources for the study was time, which relates to all aspects of the assessment process. Time includes allotment for teacher preparation, assessment administration, analyzing the assessment results, and using them to inform instructional practices through planning. Throughout the discussions, facilitators prompted the participants to elaborate on what would the ideal assessment look like within the construct of time. Most participants responded with the length of time each student should spend on the assessment. One teacher noted that the average student is able to focus on a task corresponding to their age in the number

of minutes. For example, "a five-year-old student should not spend more than five minutes being assessed". Throughout these discussions, participants alluded to this statement being research-based, but no actual reference was given. Although there was consistency among the groups that assessment time should not be excessive, there were a range of experiences that teachers shared that illustrated some affordances on the previous inference, such as a teacher assessing 7-year-old students for a 15-minute assessment.

Teachers agreed that the amount of time spent on assessment should be developmentally and age-appropriate, aligned to the assessment's purpose, and not excessive. In terms of ideal conditions, teachers said that teacher preparation for the assessment should not be time consuming. A few teachers noted that mornings may be the ideal time to assess students, "while they're sharp and ready to go and they're giving you their best." Participants concurred that the ideal assessment is short, requires little preparation, is manageable in small groups or one-on-one, but offers informative data about students' understanding of concepts. Some of the teachers' responses about ideal time are highlighted in figure 6 from the Miro whiteboard.

Figure 6

TAP Ideas on Time

assessment should be easy to use; give it and get it; can't do extra prep; need to get good data that is easy to interpret and turn around for instruction

Length of assessment should be age appropriate.

attention span ~ age, so 6 to 7 minutes for 6 or 7 year olds

time/length of test challenge~get better data from short tests in small groups~esp at young age

time of day - AM best PM not ideal

Assessment Challenges

During the design charette activities on ideal, classroom-based, formative assessments, the TAP also pointed to the challenges of assessments in K-2 classrooms and offered some ideas on how to mitigate such issues. These group discussions, as well and the driver and preventers submissions, helped us to investigate the following research question:

2. What challenges do teachers face when implementing classroom-based, formative assessments with their students? How do teachers ameliorate these challenges?

Similar to the ideal assessment, findings from the TAP centered around the assessment format, administration, test anxiety, and time.

Assessment Format

All of the TAP participants expressed concern about teaching and assessing students in an online environment. Due to the COVID-19 pandemic, the TAP finished the 2019-20 academic year virtually and were facing the same challenges for the start of the 2020-21 academic year, which coincided with our data collection. Several teachers emphasized the importance of performance-based assessments to understand students thinking. Teachers wrote questions in their drivers and preventers submissions like "how might a performance-based assessment be formatted to work in an online environment?" Other teachers were concerned about establishing relationships with students that they had not met or taught in-person. One teacher explained:

> "Something that I think will present a really great challenge is that if we don't know the kids and then we're trying to assess them virtually. And a lot of us need that data right away so that we can figure out how to tailor our instruction, figure out what our next learning progression is going to be. If we don't have that physical relationship, we thought that that would present a pretty great challenge."

Similarly, teachers worried that assessing students online or through an electronic device may muddy their view of their students' process. Another teacher shared:

> "…seeing the process is something that we value in an assessment. That's why, when it is small group, or it is one-on-one, we can watch them as they're taking the test, we can hear what they're thinking, see what they're thinking as they're writing it down, or as they're talking through it and with technology that's something else that might be difficult is being able to visually see how they're getting from point A to point B."

Some teachers wondered how manipulatives could be incorporated into the assessment in an online or computer-based format. One kindergarten teacher explained:

> "I know the first couple of weeks in kindergarten, even first couple of months, we're letting them usually use manipulatives even for formal assessments. So, I think that presents a challenge when it comes to technology. I know there are some certain sites and different resources that you can use manipulatives online.

> But I do think when they're that young, especially in regards to math, learning
> that one to one, they really need the physical object for a little while."

In general, several teachers were concerned about the validity of assessment results when the tests are administered virtually. Others noted in their individual drivers and preventers submissions that the assessment could be built to leverage technology so that teachers see the student process through visual and audio recordings. One teacher wrote the following suggestion "I wonder if assessments need to be accessible for teachers and students keeping in mind hybrid modalities of schooling now and in the future?"

Administration

During the group design charette activity several teachers emphasized the importance of administering the hands-on, performance-based assessment to students one-on-one or in small groups. However, some teachers wrote in their individual drivers and preventers submissions that they do not have time to work with students one-on-one in this manner. One teacher commented that students may need both hands-on as well as paper and pencil assessments, depending on their age. These teachers also noted that they would need an assistant in their classroom to oversee instruction with the rest of their class if they were afforded the time to administer these types of assessments.

Some teachers were concerned about leveling within the administration of the assessments. One kindergarten teacher explained her students start school with a variety of experiences—some have completed a pre-kindergarten program and others have little to no experience in a school setting. She noted "sometimes it's hard assessing all the different levels, especially in the beginning when you have to figure out where everybody's at, it can definitely be a struggle." Another teacher wrote "how can you create a progression within an assessment with so many levels of math and math skills?" Teachers requested differentiated and flexible assessments; however, they were uncertain about what exactly that would look like in practice.

Test Anxiety

Tests are often associated with anxiety and the TAP openly wondered; how can we create assessments that feel less intimidating for our youngest learners? Some teachers suggested limiting the frequency and/or the length of the assessments, which is discussed in more detail in the next section. Others recommended using play-based assessments or incorporating elements of play/games in the MMaRS assessment tools as they are developed so that the students may not even realize they are being tested. Social-emotional learning (SEL) and wellness are important challenges that the TAP noted should also be considered by the MMaRS design team.

Time

Similar to the discussions about ideal time, time was conversely a challenge. As highlighted earlier, some teachers cautioned that one-on-one assessments are time-consuming so they would need an instructional assistant to work with the rest of the class during this type of administration. The TAP also expressed concerns about the length of the test for students. One teacher summarized her group's charette discussion and said "…if they [the students] cannot sit

still for the full five minutes or their mind starts to wander after 10 minutes, then an assessment might not be as effective … we'd want to see short assessments." Other concerns related to time included the frequency of the assessments. One of the teachers commented that "it almost seems like we're revving up for an assessment and then we're letting down from assessments and we're revving up again."

Another teacher captured several of these sentiments during the design charette activity:

> "I don't think you ever hear a teacher complain that you're getting too much information from an assessment. That's not what it is. It's that the assessment takes too much time to administer. And then to understand as the educator, we're spending too much time in a planning period, trying to dissect and figure out what this assessment just gave us and our students, rather than learning the new information or spending the entire time taking something. When it only takes us as a teacher three or four minutes in the moment. So, it's not necessarily testing too much. It's the time that's equated with it."

To ameliorate some of these challenges, teachers suggested providing instructional assistants to help with their classes during one-on-one assessments or administering the test in small groups. They also suggested breaking up the content of the tests into small batches to keep the length of the assessment manageable and individualized for their K-2 students. Finally, a few teachers suggested limiting the administration of formative assessments to three times per year, similar to the DRA, so at the beginning, middle, and end of the year. Some of these solutions are highlighted from the Miro whiteboard in figure 7.Figure 7

TAP Ideas to Ameliorate Assessment Challenges
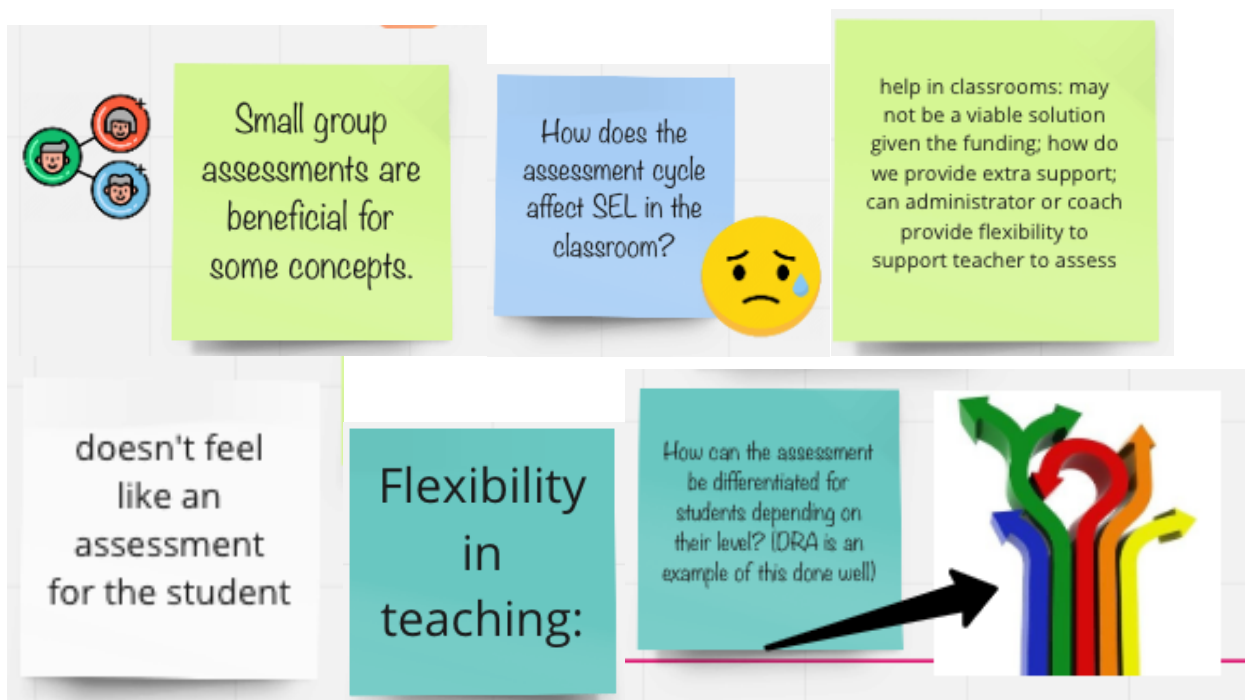
Use of Assessments

The second goal of collaborating with the TAP on the MMaRS project was to iteratively refine the use case to understand how the teachers would like to use the formative assessments. Drawing from the summary statistics using NVivo, "assessment use and outcomes" was the second most frequently coded node based on the number of coding references. (The "ideal assessment" node had the highest number of coding references.) These and the other node frequencies are displayed in **table 2**.

Table 2. Nodes Compared by Number of Coding References

Nodes	Number of coding references ⌄
Nodes\\Assessments (Ideal)	251
Nodes\\Assessments (Use & Outcomes)	132
Nodes\\Assessments (Ideal)\format (ideal)	124
Nodes\\Assessments (Ideal)\observation & understanding (ideal)	123
Nodes\\Assessments (Challenges)	115
Nodes\\LP Use	115
Nodes\\Context	101
Nodes\\LP Understanding	90
Nodes\\Assessments (Challenges)\observation & understanding (challenge)	75
Nodes\\Assessments (Ideal)\other existing tools or assessments	61
Nodes\\Assessments (Ideal)\time (ideal)	59
Nodes\\Assessments (Challenges)\format (challenge)	52
Nodes\\LP Changes & Recommendations	45
Nodes\\Assessments (Challenges)\time (challenge)	37
Nodes\\LP Comfort Leading PD	26
Nodes\\Assessments (Ideal)\favorite classroom assessment	24
Nodes\\LP Understanding\pre-understanding	22
Nodes\\LP as a Tool	18
Nodes\\Assessments (Challenges)\anxiety (challenge)	14
Nodes\\LP Challenges	10
Nodes\\Participants did not address	5

The specific research questions we studied about this topic included:

3. What type(s) of data do teachers want most from a classroom-based, formative assessment?

4. How do teachers use data from classroom-based assessments to plan their instruction?

In general, the TAP reported that they want quick but informative data about their students that can be easily interpreted and actionized in their classrooms. The teachers said they would want to use these data to make grouping decisions, which are based on students' needs. They also want to use the assessment data to understand where students may be within a learning progression, so that they can customize their instruction to fill gaps, correct misconceptions, and provide enrichment to effectively move students along their individual LP paths toward the end goal of concept mastery.

Simple, interpretable, actionable

As iterated throughout this narrative, teachers would like assessment data that are relatively quick to collect and simple to interpret and actionize. For example, with clipboard cruising data, teachers quickly collected and documented notes about students' progress in guided reading that was loaded to a google spreadsheet and shared with the students' other teachers. Teachers referenced this documentation to track student progress and know what the student needed to work on the following day or week. Teachers noted that there is a lack of formative math assessments that are easily administered and useful for teachers. The TAP often referenced the utility of the DRA and the accompanying instructional kits that are aligned to the DRA assessment results. These kits offer a useful rubric for teachers that is immediately actionable and provides a model for what teachers would like to see in our forthcoming formative assessment.

Differentiated to monitor progress and inform grouping

The TAP agreed that they would use results from formative math assessments, so long as they were differentiated, to monitor progress and inform how they create instructional groups. One teacher explained "… the data should help us plan instruction for differentiation, like reading groups. It would tell me the specific areas my kids need to develop, what they already know and what they're ready to learn so they can get to the next level." Another teacher "commented that "if you could identify student's specific levels or where they fall on a learning progression through a differentiated math assessment, it would really cut down on your planning time because it would help you identify what groups you would need in math."

A third teacher shared details about the formative assessment process at her school and ideal use:

> "…once I give a formative assessment and I come back and our team collaborates together, a part that I would think would be how to group students based off of the information that you have acquired from the assessment. And I find that a lot of times, we give an assessment and then teachers are kind of left to figure that out in a collaborative setting. But if there was almost some sort of, I say the word rubric lightly, but guideline, as you know, here's where students fall within this content learning.… Almost that vertical aspect to it, but even more within depth of that content area rather than just the grade level area would be ideal."

Some TAP teachers specified that they use formative assessment results, such as the DRA, for initial grouping but that their groups are flexible and frequently change. One teacher commented:

"…what's nice with DRA is that it's really just as a base.… In September it gives us their beginning of the year level, but kids can jump back and forth all throughout until we officially reassess again in January.… [E]ven though Johnny might start a two, I don't have to wait to bump him up until January. If he's ready to go, if I notice he's ready to move up again, he can move up in September to a three. So that's … why I love the idea of having something like that for math, because it is such a good starting off point."

Another teacher agreed and added these types of math data would enable continuous and differentiated instruction in small groups:

"And I think for me, it'd be exciting because I do not do a whole lot of whole group instruction in my classroom. The majority of it is small group and stations and things like that. And if you had that, you could see, okay, this group needs to be a math group because they need to work on this specific skill. I feel like it would just be really beneficial. It makes it easy to pull the kids who need to develop, if there's a gap or a misconception, you can pull those kids immediately and give them that kind of instruction so that way it's continuous."

Vertical / horizontal growth and connections to LPs

The teachers made connections between learning progressions and their use of formative assessment results. Specifically, they wanted the assessment data to help them design their instruction to know "what skill comes next," (horizontally) and inform how they can help deepen their students understanding of concepts (vertically). One teacher equated this process to existing assessments in reading:

"But how do we marry these learning progressions and how the natural flow of learning and student processing and development? Mirroring that in a math curriculum. The last pod I was in, we talked a little bit about things like English assessments and literacy assessments where we have these DRA or even I have Fountas and Pinnell that can now be used. How do we have this math kit, where we can structure or take students on and assess students based on this progression, because we found that that works."

Other teachers echoed the need for instructional "kits" that are vertically and horizontally aligned to the math skills taught in the early elementary grades. One teacher suggested "…I don't know if it could be a kit model … with all of these tabs that are linear in many ways, but then also horizontally, and are they vertically aligned? Can we make these vertically aligned as well as horizontally aligned? … I'm thinking about how we can drill down depth within these models."

Three other teachers built on the reading kit concept and shared a detailed example of how they use the DRA results to assign groups and books for their students within a roadmap, like LPs:

TAP A: Well, that helps me know what level of book to assign them for their independent reading time for their homework logs, everything like that. So it drives my differentiation for the whole year in their reading groups and

TAP B: Yes, for sure the reading groups. That helps with who's going to be in. Same thing that TAP A said with what books we give them. It really kind of maps out a lot

TAP C: Because it shows you the specific areas that students are ready to develop. It tells you in a continuum almost, what do they already know? So, if I have a student that's on a level four, I know that they have to know, 70 sight words or something. So if a student understands base 10 blocks, I know that they understand all of this prior knowledge. So therefore I know on this level I needed to develop these three key things for the student to move to the next level.

TAP A: Yeah. I liked that like kind of like a roadmap.

TAP C: Exactly.

TAP A: Which ties back to learning progressions. It's like it was all planned.

RME facilitator: Okay. So … the data should help us plan instruction for differentiation, like reading groups. It would tell me the specific areas my kids need to develop, what they already know and what they're ready to learn so they can get to the next level.

TAP C: Right. I think that takes out a key chunk of that planning time as teachers, when we sit there and we have all this data and we say "okay, now what do we plan for instruction?". And you're having to come up with nothing, it's right there in front of you. It's easy to group students and it's easy to move on and to continue this process as a formative assessment.

Discussion

The findings from the 2020 TAP meeting sessions provided valuable insights about practitioners' perspectives on learning progressions and the use case of the MMaRS assessments. Their ideas about the usability, feasibility, and desirability of the outcomes will inform the development of these instructional tools. Inherently, the study design and implementation included both strengths and limitations, which we outline in the next section. Ultimately, we also learned about facilitating understanding, empathy, buy-in, and ownership from the HCD process with the TAP, which should inform our future research plans and activities on the MMaRS project.

Study Strengths and Limitations

The HCD methodology puts the end user of a program or product at the center of the development process with designers. For the MMaRS project, the TAP participants served as the voice of K-2 teachers—who will be the end users of the MMaRS assessments and instructional tools. All ten TAP members participated in both meeting sessions and offered unique insights about their understanding and perceptions of learning progressions, as well as their formative assessment needs and wishes. The study design incorporated multiple data sources including data collected from group discussions as well as individual reflections documents.

All ten of the TAP participants are teachers within the Dallas-Fort Worth metroplex in the state of Texas. These teachers' experiences and contexts may or may not be representative of K-2 educators who work outside this geographic area. This limitation does not mean that our findings may not be applicable more generally. The feedback and input from the TAP contribute to theory about LP and formative assessment use that may be extended to other cases (Maxwell, 2005; Becker, 1991; Yin, 1994). Nevertheless, future studies may consider engagement with teachers who work in other states.

Considerations for Future Research

Engaging with the TAP helped us study how the learning progressions may best facilitate use of the NRR and SR formative assessments to guide instructional practice and decisions. As stated in the introduction, the learning progressions form the context that the NRR and SR formative assessments live within. So, studying teachers' understanding and reactions to the learning progressions are important steps toward the prototype and testing phases within the HCD process for the assessments. If we use the findings outlined in this technical report from the TAP sessions, we can help teachers better utilize the learning progressions and corresponding subcomponents alongside the data from the formative assessments.

We propose planning future sessions with the TAP that showcase the specifics of the MMaRS learning progressions as well as item and test specifications, the technological interface for the assessment delivery, and the reports based on the assessment results. The TAP participants shared their excitement about the learning progression concepts and their potential use in their K-2 classrooms. Continued engagement with the TAP during the design phases of the study will help maintain this momentum and provide valuable insights about implementation. This process will also help with dissemination efforts, which fall within the "tell" ring of the HCD process shown in figure 1.

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Appendix A – Snapshot of Research Team Storyboards
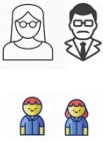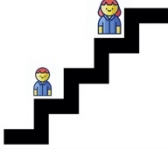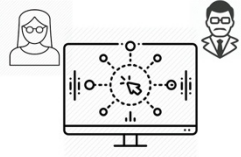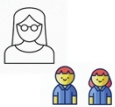
I like the stair step image, but am curious why it is not a continuous path.
I wonder if the "adults" are teachers or parents

I like the diagram of the progression

I wonder if all students take the same stairs?

I wonder how you are using the stair step diagram in your story

Team Blue Storyboard

Users ----->>>	Assessment happens	Teachers look at assessment results organized using the learning progressions.	The learning progression can help determine what the next possible step is. The progression is progress steps. You need to move up the steps in order.
Instructional design	Instructional intervention	Greater student conceptual understanding

I like the idea of using the LPs as a guide
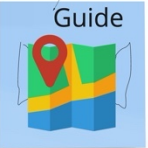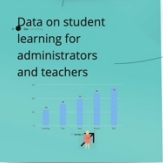
I'm wondering how the passing of time could be incorporated to tell your story of the use of learning progression.

I agree that the LP is a continuum with increasing complexity.

Show the way

Team Purple Storyboard

Knowledge and skills along continuum of increasing complexity

Guide

Data on student learning for administrators and teachers

Students are on the trajectory based on current skills and knowledge

Targeted instruction based on strengths and needs

1. I like the idea of Increasing Complexity.
2. I'm wondering about the targeted instruction.
3.

Questions
-WHAT ARE LEARNING PROGRESSIONS?
-HOW ARE LEARNING PROGRESSIONS USED IN OUR PROJECT?
-HOW ARE THEY USEFUL?
-TEACHERS/STUDENTS/PARENTS/ADMINISTRATORS
-WHAT ARE THE ESSENTIAL WAYS IN WHICH TEACHERS/STUDENTS SHOULD USE LEARNING PROGRESSIONS?
-HOW DO LEARNING PROGRESSIONS PLAY A ROLE IN THE FINAL OUTCOME OF OUR PRODUCT?
-HOW MIGHT LEARNING PROGRESSIONS IMPROVE K-2 TEACHERS' LIVES?

Appendix B – TAP Informational Survey

This survey will take approximately 15 minutes to complete.

This survey renders best on desktop or laptop computers, not mobile devices.

Teacher Availability for Virtual Meeting Sessions

Please **select all** of the dates and times that you are available to attend the TAP meeting sessions I and II. Both meeting sessions will be virtual and conducted via zoom.

	Session Times		
Meeting Session I (1 hour)	11:00AM	2:00PM	5:00PM
o Wednesday – July 8, 2020	☐	☐	☐
o Thursday – July 9, 2020	☐	☐	☐
o Friday – July 10, 2020	☐	☐	☐
o Wednesday – July 15, 2020	☐	☐	☐
o Thursday – July 16, 2020	☐	☐	☐
o Friday – July 17, 2020	☐	☐	☐
Meeting Session II (2 hours)			
o Wednesday – July 22, 2020	☐	☐	☐
o Thursday – July 23, 2020	☐	☐	☐
o Friday – July 24, 2020	☐	☐	☐
o Wednesday – July 29, 2020	☐	☐	☐
o Thursday – July 30, 2020	☐	☐	☐
o Friday – July 31, 2020	☐	☐	☐

Teacher Demographic Information

Please fill out the demographic information below.

1. Please fill in the following information

   First Name
   Last Name
   Home address (street, City, State, Zip)

2. Please select the option(s) that best reflects your level of education

	Yes	No	In Progress	If yes OR in progress, please list your degree below
Bachelors Degree	☐	☐	☐	

Masters Degree	☐	☐	☐	
Post Masters Degree	☐	☐	☐	

3. What is your current title?
   - o Classroom teacher
   - o Special education teacher
   - o Math coach
   - o Interventionist
   - o Paraprofessional
   - o Other

4. Select the number of years experience you have in each area (If greater than 20 years, select 20 years)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Current Position																					
Teaching Experience																					
Years teaching Elementary School (K-3) Students																					
Teaching in current school																					
Mathematics classroom teaching experience																					
Special education mathematics teaching experience																					

5. Please select the option(s) that best fit your credentials
   - o K-6 teaching credential
   - o K-8 teaching credential
   - o Multiple subject (K-12)
   - o Secondary, single subject mathematics
   - o Mathematics specialist
   - o Reading specialist
   - o Special education
   - o Administrative

o   Other (Please specify)

6. Gender
    o   Male
    o   Female
    o   Other

7. Race/Ethnicity
    o   Asian America/Pacific Islander
    o   Black/African American
    o   Hispanic/Latino American
    o   Native American
    o   White/European American
    o   Multiracial
    o   Other (Please specify)
    o   I prefer not to respond

8. Age
    o   20-29 years
    o   30-39 years
    o   40-49 years
    o   50-59 years
    o   60 years or greater

9. How many minutes of instruction are devoted to mathematics each day (pre-COVID-19)?
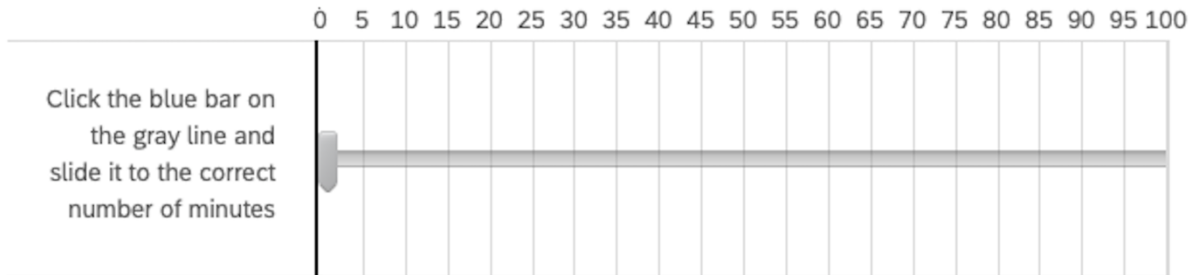
10. What instructional model(s) do you use in your classroom? (Please select all that apply and add the percent of time spent for each model.)

	Percentage of time spent
o Whole group instruction	
o Small group instruction (not math workshop)	
o Whole group classroom routine (calendar math, number talks)	

o Math workshops	

11. Within the last year, have you received any professional development in the following areas?

	Yes	No
Mathematics Instruction	☐	☐
Using data to inform math instruction	☐	☐
Using manipulatives in mathematics teaching	☐	☐
Mathematics Assessments	☐	☐

[skip pattern if yes, then…]
12. How many hours of professional development in mathematics instruction?
13. How many hours of professional development in using data to inform math instruction?
14. How many hours of professional development in using manipulatives in mathematics instruction?
15. How many hours of professional development in mathematics assessment?

Appendix C – TAP Instructions on Professional Development

Adapted from the TEA ESTAR/MSTAR Learning Progressions Course

Welcome to the Teacher Advisory Panel (TAP)! We are excited that you accepted the nomination and are available to join us via Zoom on Thursday, July 16, from 11-12pm. We will send a separate email with the zoom meeting invitation and instructions on how to join the virtual discussion. In the interim, please set aside approximately 90 minutes to complete an online course offered by the Texas Education Agency (TEA) about learning progressions before the TAP focus group session on Monday, July 13. The examples in this course are not specific to kindergarten through grade 2 classrooms. However, the lessons offer some baseline information and a common language around the concept of learning progressions that will provide useful context for the focus group discussion.

Instructions

To complete the three assigned lessons, please visit the following link:

http://texasmathsupportcenter.org/?page_id=26

Complete *Lesson 1: Introduction and Overview*, *Lesson 2: What is a Learning Progression?,* and *Lesson 4: Using the ESTAR/MSTAR Learning Progressions for Instruction*, highlighted in the figure below before the first focus group meeting.

We have attached an adapted copy of the learning portfolio that is customized to include the activities covered in lessons 1, 2, and 4. Please open the learning portfolio file and respond to the prompts as you complete the assigned lessons. Then answer the final two questions at the end of the portfolio when you have finished the three assigned lessons. Finally, please return your completed learning portfolio materials by Monday, July 13, before the focus group on Thursday, July 16. Below are the descriptions for each assigned lesson from the TEA syllabus.

Introduction and Overview
In this lesson, you will review the Texas Algebra Ready Initiative (TXAR), Texas Response to Curriculum Focal Points (TxRCFP), and where the ESTAR/MSTAR Learning Progressions fit within in the MSTAR Project professional development system. (Estimated time—15 minutes)

What is a Learning Progression?
In this lesson, you will distinguish between the term "learning progression" and other common terms, identify elements that comprise a learning progression, examine examples, and identify the importance of understanding and using learning progressions. (Estimated time—40 minutes)

Using the ESTAR/MSTAR Learning Progressions for Instruction
In this lesson, you will focus on the classroom-level implications for instruction in the ESTAR/MSTAR Learning Progressions. (Estimated time—40 minutes)

Please reach out to Toni Buttner at tbuttner@smu.edu if you have any questions. We look forward to "seeing" you on July 16th@ 11am!

Appendix D – TAP Focus Group Interview Protocol

2020 Meeting Session I

Introductions

Thank you for agreeing to serve on the Teacher Advisory Panel, also known as TAP. Today we will talk with you about learning progressions and your thoughts about the professional development session from the Texas Education Agency that you completed. The purpose of the course was to make sure that everyone has some common knowledge of learning progressions. We will also discuss your questions about learning progressions as well as the process for our next TAP meeting.

[Researcher introductions]. We are from the Research in Mathematics Education unit at SMU. We are currently working on a National Science Foundation (NSF) grant to develop an early mathematics classroom-based assessment focused on numeric relational reasoning and spatial reasoning. The assessment that we are building is based on a learning progression. We are very excited about this project because there currently are no instruments that assess these critical early mathematics concepts. Your perceptions and experiences as teachers are a valuable resource to help us understand how to build these assessments so that they are useful in your classrooms.

Your participation in the study is anonymous. *In our reporting, the names of the districts and schools as well as your names will not be identified. Anything that is shared in this conversation should be considered confidential by your peers and we ask that you do not share any aspects of our discussion with people outside of the group.*

The focus group should last about one hour.

[Remind TAP that we are recording the zoom meeting and assure them the recording will be used for RME's research purposes only. Note that we can turn off the recording at any time if they would prefer.]

Do you have any questions before we get started?

Questions

Individual response questions:
These first few questions are for background information and context.

1. Please briefly introduce yourself and include
   a. how long you have been teaching,
   b. what grade(s) you currently teach, and
   c. something unique about yourself.

2. What is your favorite classroom assessment practice? Why?

3. If I were a new teacher in your school, how would you describe the school's climate?

Group response questions:
These next questions focus on the TEA professional development session. Please feel free to reference your learning portfolio notes at any time during the session.

4. What, if anything, surprised you about learning progressions from the TEA professional development session? Why? [RQ1]
   a. *[prompt]* What did you think about the organization of the content and skills of the learning progressions in the session?
   b. *[prompt]* What do you think about the level of specification of the content?

5. If learning progressions were a tool in your garage what tool would it be? Why? [RQ2 & RQ3]

6. Based on your current understanding, how might you use learning progressions? Please describe and walk us through a possible scenario for your classroom. [RQ2 & RQ3]
   a. *[prompt]* How might you use learning progressions to plan instruction?
   b. *[prompt]* How might you use learning progressions when thinking about and planning content?
   c. *[prompt]* How might you use learning progressions to understand your students' progress?
   d. *[prompt]* How (if at all) would you use learning progressions for instructional grouping?
   e. *[prompt]* How (if at all) might you use learning progressions to communicate with parents or other stakeholders?

7. Now imagine that you have been tasked with leading a professional development workshop on the topic of learning progressions. Describe how you feel about explaining learning progressions to your team members. Why do you think you would you feel that way? [RQ1, RQ2, RQ3]

8. What, if anything, would you change about learning progressions? Why? [RQ2]

9. Is there anything else that you would like to share about learning progressions or the TEA professional development session?

10. Are there any materials or documents (for example, notes from the learning portfolio) that you would like to share with us related to the topic?

Appendix E – NVivo Codebook

Nodes

Name	Description	Files	References
Assessments (Challenges)	Any reference to assessment challenges, including format, time, administration, preventers	17	115
anxiety (challenge)		7	14
format (challenge)	Tasks broken up in parts, low prep requirements, does not feel like an assessment, flexible and customized to students needs, assessment math not language, manipulatives	12	52
observation & understanding (challenge)	Challenges of the observation component of assessment to understand students' skills and gaps—for example, COVID and virtual learning. Play based, performance-based, teacher administered 1:1 or in small groups, etc. may be challenging for multiple reasons.	16	75
time (challenge)		12	37
Assessments (Ideal)	References to ideal assessments—format, time, administration, drivers, etc.	24	251
favorite classroom assessment	Opening question from mtg1 on favorite classroom assessment practice.	7	24
format (ideal)	Tasks broken up in parts, low prep requirements, does not feel like an assessment, flexible and customized to students needs, assessment math not language, manipulative	17	124
observation & understanding (ideal)	Ideals of the observation component of assessment to understand students' skills and gaps. Play based, performance-based, teacher administered 1:1 or in small groups, etc.	16	123

Name	Description	Files	References
other existing tools or assessments		13	61
time (ideal)		14	59
Assessments (Use & Outcomes)	References to ideal use of assessment outcomes, including student assessment data.	18	132
Context		9	101
LP as a Tool		5	18
LP Challenges		3	10
LP Changes & Recommendations		16	45
LP Comfort Leading PD		5	26
LP Understanding		20	90
pre-understanding		11	22
LP Use		20	115
Participants did not address		4	5