Developing Evidence-Based Teacher Practice Briefs with Middle School Computer Science Teachers

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ABSTRACT

Engaging teachers in research has been shown to increase their self-efficacy and other factors related to increasing students' learning and growth. In this project, we partnered education researchers with computer science (CS) middle school teachers in the U.S. to develop a set of equity-focused teacher practice briefs that address a problem of practice that the teachers experience in their classrooms. Using a prescribed development process previously developed by Bell and Rhinehart for creating these briefs, teacher involved in the process saw their self-efficacy, professional networks and pedagogical content knowledge with respect to equity increase. The process allowed educators to reflect on their understanding of their particular problems of practice, while also collaboratively with expert researchers in the field to interpret previously published research results. The teachers and researcher teams created three briefs for the broader community to use. Throughout this four-month process, we learned how to improve the format for our particular needs, which included ensuring all voices were heard and equity was at the forefront of the work. In this *experience report*, we detail the process we used and report on lessons learned about the process from the teachers and researchers who participated. We also provide recommendations for others interested in using this method to engage in-service or pre-service teachers.

CCS CONCEPTS

• **Social and professional topics** → **Computing education**; **Computing education programs**; **Computer science education**.

KEYWORDS

teacher practice briefs, K-12, teachers, challenges, computer science, computational thinking, researchers, research and practice, practice, lessons learned

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1 INTRODUCTION

Research Practice Partnerships (RPPs) in K-12 computer science (CS) are becoming a growing way to bridge the gap between education researchers and practitioners [12]. While the term *practitioner* in RPPs includes a variety of practice-organization roles [10], teachers often play a unique role in providing valuable insight on authentic classroom practices to researchers, including participating in the design of classroom materials, and act as information conduits to their peers [18]. However, RPPs are multi-year projects that can require significant resources and time commitments from all involved [2–5]. Even when RPPs are able to receive appropriate levels of funding, their intensity and longevity can be barriers for practitioners to participate [4, 9]. Thus, the meaningful process of researchers collaborating with teachers to achieve a shared goal of improving classroom practices (as well as the benefits from such participation) are limited and come at a significant cost.

As part of a recent pilot study, we brought together middle school CS teachers and education researchers to study evidence-driven, published research as a foundation for creating a set of Teacher Practice Briefs (TPB), with the hypothesis that we would see similar impacts on teachers that RPPs have. Bell and Rhinehart define TPBs as "...condensed document designed to support teachers with research-based information, practice briefs are often focused on teachers' problems of practice, particularly as they relate to equity" [1], while Hatch-Tocaimaza and Hu define briefs as articles that provide "...empirically based, conceptually coherent recommendations and guidance using the best and most current research to tackle a specific, urgent challenge in everyday language that practitioners can use in immediate, real-world scenarios they face every day" [8]. TPBs can narrow the gap in evidence-driven documentation created for teachers by addressing a practice of problem that they face [11, 19] by encouraging reflection on their practice and offering small, concrete actions to improve their practice. TPBs can also be used as a way to define common language around its topic, such as the term *equity* [15] and by professional development providers, education leaders, and researchers to better understand the problems of practice teachers face and how to support teachers in their desire to overcome them. Beyond in-service teachers, Hatch-Tocaimaza and Hu also postulate that the TBP development process can be integrated into pre-service training due to their rigor as well as increasing novice teacher's engagement with research.

Our project goal was to understand how the development of TPBs impacts middle school CS teachers as they work with education researchers to identify evidence-based promising practices

that address teachers' problems of practice through an equity lens. Utilizing the resource-intensive development process created by Bell and Rhinehart, we served as facilitators to guide the teachers and researchers in the creation of the briefs [1]. As a major focus of our overall study, we investigated changes to teachers' self-efficacy, classroom practices, and understanding and use of CS education research [13]. While there is a dearth of scholarship focused on the Bell and Rhinehart's development process, having teachers and researchers collaborate on creating TPBs is a unique way to bring these two groups together with impacts that we have seen to be similar to those of teachers engaged in RPPs [13].

For this particular experience report, we focus our attention on how we used the Bell and Rhinehart development process and how the teachers perceived it. We also provide recommendations for others who may want to engage in creating TPBs.

2 BELL AND RHINEHART TPB DEVELOPMENT PROCESS

The Bell and Rhinehart development process was created primarily as a guide for RPPs to bridge the known research-practice gap [17]. Utilizing this process, the authors of this report describe the prescriptive process of creating TPBs, but leaves various implementation decisions to the facilitators. The authors first frame the brief development process with these important guiding principles:

- Integrate a focus on equity throughout each tool
- Focus on a specific, broadly felt problem of practice
- Gather the best knowledge from both research and practice to help readers more fully understand each issue
- Highlight what people in different roles can do to address the problem of practice, providing context, actionable advice, strategies, and tools, all of which should connect to educators' everyday work
- Suggest ways to take action with respect to the problem of practice by linking to other tools, articles, and resources
- Prompt further reflection and support discussion among colleagues [1]

This process has two active parts that detail how to launch a brief development initiative and how to author a new TPB. With respect to launching a brief development initiative, the authors recommend four sub-processes:

- Learn Why a Brief Development Initiative is a Useful Partnership Activity. This orients process adopters "...to share research-based knowledge from their work quickly and straightforwardly with educators who can readily use the information to inform their practice." [1, p. 2]
- Identify the Audience, Purpose, and Structure for the TPBs. This provides a layout of the brief with the reader in mind. Identifying a sample template (Figure 1) or creating a new template ahead of time will make it easier to create its content.
- Get Feedback from Stakeholders on the Approach. Pilot test the TPB with those who may be reading it for content and make adjustments based on feedback.
- Identify an Editorial and Production Team. This includes identifying the editorial and production strategies for your briefs in advance, so the production process goes smoothly.

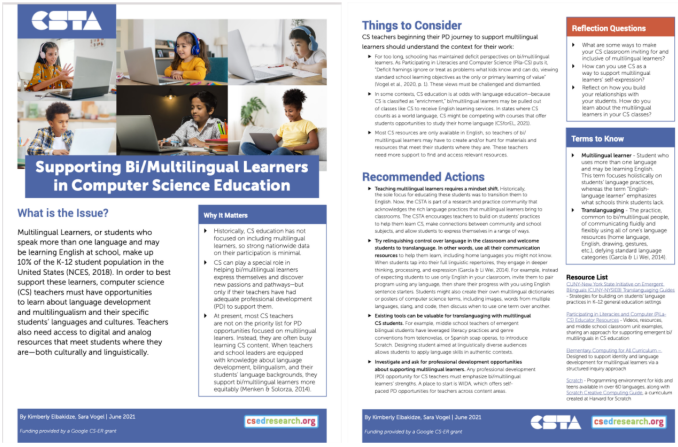

Figure 1: Thumbnail image of practice brief created in Spring 2021.

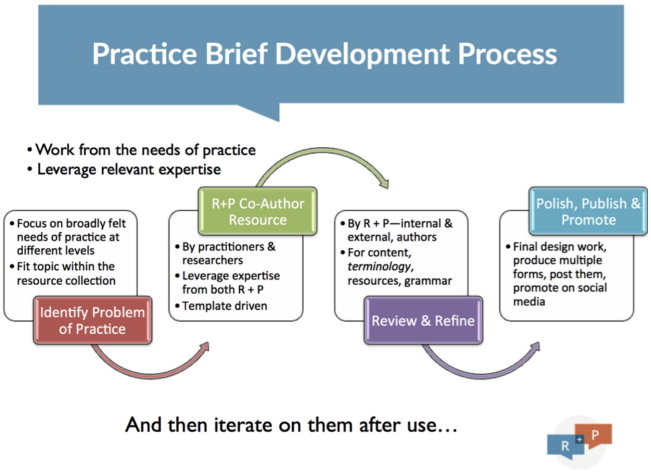

Figure 2: Bell and Rhinehart's practice brief development process for authoring a new practice brief [1]. This work is provided for educational use under Creative Commons Attribution NonCommercial ShareAlike 4.0 International license by the Research+Practice Collaboratory 2016.

With respect to the actual authoring of the brief, Bell and Rhinehart prescribe the following linear, repeatable steps (Figure 2):

- Step 1: Identify a problem of educational practice that teachers face
- Step 2: Researchers and practitioners co-author the initial draft of the brief
- Step 3: Researchers and practitioners review and refine the draft after receiving feedback from internal and external reviewers
- Step 4: Polish, publish, and promote the brief

The template we chose was similar to the templates provided by Bell and Rhinehart, which includes the following sections: What the issue is, Why it matters, Things to consider, Recommended

Actions, Reflection Questions, Other relevant terms or interesting facts that the reader should know, and Additional Resources.

3 METHODOLOGY

Given that the purpose of this experience report is to share our experiences using Bell and Rhinehart's development process, we describe our adaptation of the process and our study.

3.1 Our TPB Implementation Process

Our process first involved gaining a better understanding of the overall process by considering the guiding principles as well as the infrastructure needed to deliver it. Once we gained a better understanding, we planned our four-month schedule (see Table 1), estimating 2-3 hours per week for participants.

Since we were not working within an RPP (for which the process was designed), we changed the beginning of the process by interacting with only the teachers in the first five weeks. This gave the teachers time to establish rapport, gain an understanding of what a research article contains and carve out the specific problems of practice they wanted to focus on for their brief. This also ensured that the teachers and their problems of practice were uniquely centered within this process and that their voices were integrated into the draft sections of the practice brief. During this time, the teachers worked in pairs and started tackling sections of the brief, including what the topic for the brief entailed and why it was important.

We introduced the researchers in week six, starting with an icebreaker and having the teachers share what they had learned so far. From there, the researchers and teachers worked together, guided by the facilitator, to complete out each section of the brief. Figure 3 shows the brief development process we used.

3.2 Our Study

Our study, as noted in Section 1, explored the impact of this process on teachers using a qualitative protocol that was approved by an ethics (IRB) board. As part of our final interview protocol, which occurred at the end of the project, we asked about the teachers' opinions regarding the process of creating the TPBs. We provide some context of the teachers and the research here, along with the questions asked and our coding and theming process.

3.2.1 Participants. To recruit, we created a screening questionnaire that informed teachers about the study and asked for key information including: demographic characteristics, years teaching middle school teaching, years teaching CS, and the name and location of the school where the teacher currently teaches; the three most important problems of practice they face in their classrooms when teaching CS; and whether or not they had engaged in any research studies before. From this call, we received 83 entries.

Given that this was a pilot study that would be conducted virtually, we limited the number of problems of practice to three areas and chose to form three teams of two teachers and one researcher, each focused on one problem of practice. We excluded teachers who had conducted research in the past to form a group of teachers that were new to education research. Using the school name and location for each entry, we identified the school demographics for each teacher's school using NCES data [20]. This process included identifying if a teacher taught at a Title I school[1] and composition of the student body race/ethnicity. Through this process we identified nine prospective teachers.

Based on the teachers' identified problems of practice, we carefully considered them as well as our interests and goals in developing briefs focused on equity. We then chose the following three problems of practice:

- Meeting the needs of emergent bilingual/multilingual students learning CS
- Recruiting for and retaining girls in CS classes
- Teaching CS in ways which attract and retain students identifying as members of marginalized groups

Of the nine teachers identified, we chose six based on their interest in the topic and individual/school's demographics (location, race/ethnicity, gender, Title I status). For one topic, only one teacher was available to join the study, leaving us with five teachers in total, all of whom received a stipend. Teacher demographics included one black man, two black women, and two white women in New York, Maryland, Virginia, Colorado, and Tennessee with varying years of experience (novice to expert).

To recruit three researcher participants, we considered the equity-focused problems of practice and identified CS researchers who have conducted extensive research in one of the areas. We contacted seven researchers and three agreed to lend their expertise and work collaboratively with teachers in that one focus area. Researchers also received a stipend. The researchers were all white women located in New York, Colorado, and Nebraska.

At the conclusion of the brief creation process, three practice briefs were published [6, 7, 16].

3.2.2 Data Collection. The interviews took place after the conclusion of the initiative (May 2021) and were audio recorded and transcribed using a transcription service. We developed the interview protocol, which was then reviewed by an external researcher who was experienced with qualitative research and who conducted the interviews. The external researcher was brought in to ensure a greater measure of objectivity so that we did not introduce unknown biases into the interview process. Each interview averaged 47 minutes in length (range of 29-72 minutes).

The interviewer asked a set of predefined questions with the liberty to explore answers with probing questions. The interview asked these questions pertaining to the implementation process:

- Reflect upon the process that you went through in creating the practice briefs.
  - What were the best parts of the process for you?
  - What were the most challenging parts?
  - During the process, how did you keep a focus on equity?
- Did you share your experiences in this process with others? If so, what did you share?
- Looking back, are you glad you signed up for this study? If so, why? If not, why not?

The interviewer asked other questions related to the impact of the process on the teachers. The more specific questions are

[1] In the U.S., "Title I, Part A (Title I) of the Elementary and Secondary Education Act, as amended by the Every Student Succeeds Act (ESEA) provides financial assistance to local educational agencies for children from low-income families to help ensure that all children meet challenging state academic standards" [14]

Table 1: Schedule for the practice brief development. T=Teacher and R=Researcher.

Week 1 (T)	Kick-off and icebreakers Discuss the reason for this project Reflect on problems of practice the teachers experience in their classrooms (Jamboard exercise)
Week 1 (T)	Kick-off and icebreakers Discuss the reason for this project Reflect on problems of practice the teachers experience in their classrooms (Jamboard exercise)
Week 2 (T)	Discuss the structure of a K-12 CS education research article Teachers draft answers to these questions in their groups: What is the focus of your problem of practice within your student group? What is the issue? Why does it matter to you?
Week 3 (T)	Teachers refine answers to questions from week 3 Facilitator reviews the structure of an education research article **Action item for next week:** Read research article assigned and add findings to the spreadsheet
Week 4 (T)	Review what you learned from the articles as a whole group Reconsider the problems of practice you focused on **Action item for next week:** Read assigned research articles and add findings to spreadsheet
Week 5 (T)	Review what you learned from the articles within your groups Reconsider the problems of practice you focused on **Action item for next week:** Read assigned research article assigned and add findings to the spreadsheet
Week 6 (T&R)	Meet the teachers icebreaker Review the TPB development process Teachers discuss their problem of practice and what they have learned so far with researchers Researchers provide feedback to shape up their title, problem of practice, and why it matters **Action item for next week:** Researchers provide one article for teachers to read
Week 7 (T&R)	Next five sections (overview): Things to Consider, Reflection Questions, Attending to Equity, Specific Guidance, Links to Related Resources Things to Consider - breakout session: Create a list of 5-7 things to consider Reflection questions (if time or if they come up naturally from the discussion on things to consider) **Action item for next week:** Researchers provide two articles for teachers to read
Week 8 (T&R)	Discuss articles read (breakout) Refine and finalize: Things to Consider and Reflection Questions (breakout) If time, work on Specific Guidance **Action item for next week:** Researchers provide two articles for teachers to read
Week 9 (T&R)	Share out of Things to Consider and Reflection Questions (all) Work on Specific Guidance, Links to related articles, and Equity (breakout) **Action item for next week:** Researchers provide two articles for teachers to read
Week 10 (T&R)	Refine and finalize the following sections: Specific Guidance, Links to related articles, and Equity
Week 11 (T&R)	Share out of entire brief with all teachers **Action item for next week:** Facilitator sends briefs for internal and external researcher review
Week 12 (T&R)	Refine materials based on reviewer feedback **Action item for next week:** Facilitator sends modified briefs to external teachers for review
Week 13 (T&R)	Refine materials based on reviewer feedback Cover next steps of the publication process

provided in [13]. When the interviews were coded, if an answer was related to the implementation process, we coded it as such regardless of the question the participant was answering. Therefore, our analysis (described in the next section) captured all responses from participants that related to the implementation process.

3.2.3 Data Analysis. We engaged in the data analysis process independently, conducting three passes of an open coding process across all interview transcripts to generate themes using Dedoose qualitative analysis software. We coded sentences and/or phrases that represented information related to the implementation process. Once completed, we merged our codes to identify overlaps and differences, discussed each of them, then created broader themes. This helped ensure methodological integrity and that our different perspectives as researcher and researcher/facilitator were reflected.

4 TEACHER PERCEPTIONS OF THE PROCESS

The interviews at the end of the study were the focus of our data collection and analysis for the teacher perceptions of the process. Through the coding process, we formed two themes, challenges (with constructive criticism) and positive feedback criticism. We carefully chose comments to include since the briefs are published

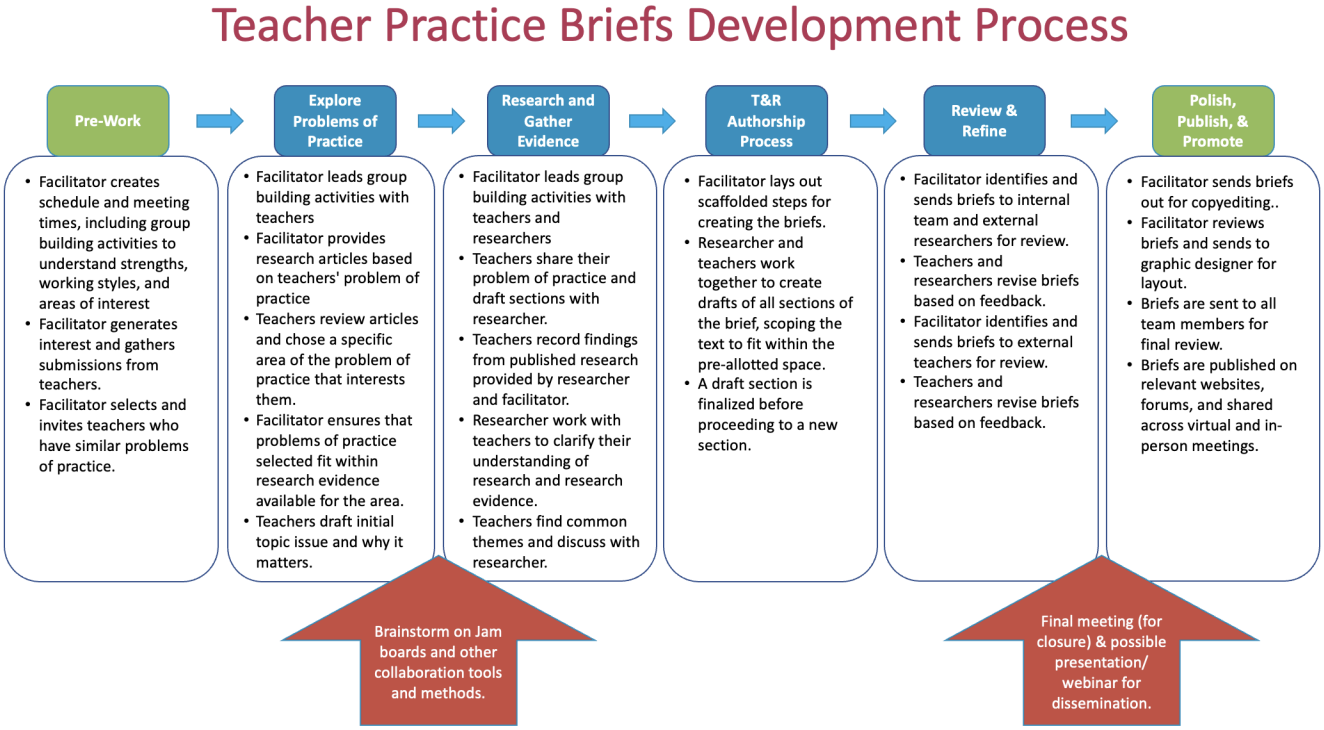

Figure 3: Our revised TPB development process. Roles: *Facilitator* is the researcher(s) who provides guidance, organization, and structure. *Teacher* identifies problems of practice to address in brief. *Researcher* shares knowledge about research with teachers and assists in the writing process.

and confidentiality could not be guaranteed. Where we do not present actual comments, we paraphrase the ideas presented from participants.

4.1 Challenges

During the interviews, teachers were asked to reflect on the implementation process and identify challenges.

4.1.1 Fear and Anxiety. Nearly every teacher participant stated some type of fear or anxiety with the portions of the process early on. Specifically, there was a reported fear around writing, anxiety around the misconception of the teachers needing to find research, and the "fear of the unknown." Anxieties about writing were stated by three of the five teachers. One teacher stated, "I told my partner I am not a strong writer, but I'm going to do everything that I have to do in order to prepare." Another teacher stated, "I was always thinking about the writing process. It was a fear of the unknown."

4.1.2 Time Constraints. A fear of the unknown supported the specific subtheme of time commitments and scheduling. When the teachers were asked to participate, they were told it would take approximately 20-25 hours in total, including weekly meetings. However, most teachers invested a total of 25-30 hours across the four months, averaging 2.5 hours per week. Teachers reflected that at points during the process they did not have enough time to read and take notes on one pre-selected article prior to the meeting. One teacher stated in the interview, "For me, it's just a time balance. There was no challenge in the work we had to do. I enjoyed coming together and meeting with my team. We met once a week every Thursday, then we would have to read the article in between. It wouldn't seem like just to have to read a 20-page article or a 10-page article in a week's time would be hard or something that you should be able to expect from a person, but sometimes it was."

4.1.3 Too prescriptive/narrow. One teacher found that the two-page prescriptive template used was very limiting, stating that "...the rules of what a practice brief is supposed to look like, it was very hard for me to meet some people's expectations around what they were expecting to receive from it, and conceding." Likewise, other teachers found that it was difficult to take all of the knowledge that they gained during the process and simplify the brief to two pages, commenting that nothing about the process was "...overly challenging except maybe editing because there was so much you wanted to add. Then you only have two pages. You have to have the graphics. You have to have the design, so it's appealing for the public to read. Tweaking and editing was probably the hardest."

4.1.4 Disconnect between teachers and researchers. One teacher reflected on a disconnect between theirs and the researcher's level of knowledge regarding K-8 education environments. The teachers and researchers worked to overcome that gap by sharing knowledge about classroom practices and how their districts and states influence those practices on their own without facilitation. This

theme of disconnectedness supports some of the reasons why having teachers and researchers work closely together is imperative, not just for the teachers, but also for the researchers.

4.2 Positive feedback.

During the end-of-project interview, teachers also reflected on the positive aspects of the process.

4.2.1 Bonding. By the end of the process, teachers felt connected to their partner. This was evident through teacher statements such as, "We just had a lot of really good conversations where we got to just really bounce off each other's energy." One of the teachers stated that they felt as if they were part of "a powerhouse team." Bonding not only took place between the teachers, but also expanded to their broader professional learning network (PLN). One statement, echoed over and over in the interviews, can be exemplified in the statement, "I've shared [the brief and my knowledge] already within my school to my peers so that they can use it."

Not only were the teachers able to bond and connect, they were also able to collaborate with like-minded colleagues. This was especially important for CS educators who are the lone CS teacher in their school and/or district. When discussing the expansion of their PLN and collaboration, one teacher stated "I don't have peers in my county to fall back on, so I'm an isolated island." This process enabled the teachers to be able to brainstorm, research, and develop resources for other teachers who are in similar settings.

4.2.2 Well-Structured. Overall, the five teachers reflected on the well-structured and organized process set up for reading current research, learning with colleagues, and writing a TPB. "This has been a very wonderful experience for me. Like I said, very, very organized. [Facilitator] facilitated very well." This concept of the entire process being well-structured can be summarized by one teacher who simply stated, "It was all planned out."

The facilitation and organization also lead to teachers' building confidence in areas they did not feel strong in professionally, particularly at it related to interpreting research and writing. One teacher stated that "At the beginning of this process, I remember [teacher] and I thinking, "Oh my gosh, we have to write something that's going to be published in a time-frame. It ended up being not stressful at all." Another stated that it "...was an excellent opportunity for teachers to get into the bottom floor of research for those that are not familiar with it. Most of people in my group had never done any kind of research... I think this was a really nice way to introduce them into research and dealing with the researcher." A third teacher stated that "It has improved my confidence dramatically. The main thing, like I said, I went and really had to look myself in the mirror. I was like, 'You've got to teach to style to your children.'"

4.2.3 Researcher Involvement. One of the teachers noted that the researchers entry was perfectly timed, stating that "[Researcher] just came in at the right time and everything came full circle." They further clarified that the teachers somewhat struggled to interpret the research through their teacher lens, since research articles were so new to them. They were unsure how to parse through the various content that they were reading. When the researcher joined, the researcher brought the clarity and shaping that the teachers needed to connect the various findings.

We found this feedback very helpful, since Bell and Rhinehart's framework was specifically developed for RPPs where the teachers and researchers may have been working together for several years. As noted earlier, our process differed by intentionally starting only with teachers to give them agency. By so doing, teachers' thoughts, perspectives, and voices were shared and rapport was established among the teachers prior to bringing in the researchers. With the feedback given and no comments received about researchers joining earlier, we will retain this structure in the future.

5 RECOMMENDATIONS

To modify this process, we recommend the following changes to this process in the future:

- Early in the process, encourage the teachers to create the habit of writing notes from the research findings within the shared document. This will better enable the streamlining of creating content for the briefs.
- Though icebreaker activities were planned with the teachers to build community, we only had a small icebreaker activity for teachers and researchers. In retrospect, based on feedback from a researcher (part of the larger study), there was a recommendation to make the icebreaker session much longer, possibly a whole session.
- Related to this, the teachers felt that a better introduction to the researchers would have helped frame how researchers can help (with the research) versus what the teachers' experiences in the classroom offered. Establishing researchers' research credibility (via their qualifications and experiences) and knowledge gaps of in-classroom experiences can further delineate knowledge strengths and gaps for the teams.
- Increase the amount of time expected for both researchers and teachers. This will ensure that teachers and researchers are more aware of expectations as they sign up to be part of the process. With this, provide teacher credentialing (either micro-credentials or continuing education credits) along with the stipend. This will ensure that teachers understand the professional development that they are engaging in and that their growth is recognized by their schools and districts.
- Grow our effort to include more teachers and researchers. Researchers and teachers both shared similar positive experiences. They recommended that we continue growing this process so we can continue sharing it with other teachers and researchers.

6 CONCLUSION

Teachers engaging with researchers can have a profound, positive impact on teacher self-efficacy and classroom practices. Beyond RPPs, we presented a replicable way to engage teachers with researchers in a process that provides agency and voice to teachers, while at the same time creating a unique relationship between teachers and a researcher who understands and can share the evidence. Based on the input from the teachers (and researchers), our process was effective. Given its many benefits, we will continue refine this process to enable teachers and researchers to fully engage in the experience and work collaboratively to create teacher practice briefs.

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