

Board 279: Failure in Focus: Unpacking the Impact of Video-Based Reflections on Museum Educator Practices

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Introduction

While the term 'failure' often has negative associations [1], there is a current focus on failure as a driver of innovation and development in many professional fields [2]. Further, failure is deemed an essential building block for developing skills such as resiliency [3], persistence [4], creativity [5], and problem solving [6], as well as other noncognitive skills such as self-efficacy and independence [7-8]. Specific to engineering, failure is viewed as a normative practice of engineers, and a practice that should be experienced by young children within engineering design projects [9-10]. As stated by Petroski [11], “One of the paradoxes of engineering is that successes don't teach you very much. A successful bridge teaches you that *that* bridge works.” Therefore, experiences with failure in engineering are touted for their ability to teach us how to learn from the mistakes, errors, and struggles that occur within the process [1, 10, 12].

Yet, while there is increased attention to inclusion of engineering in informal contexts [13-17], we have not come across any research or training materials that focus on how informal educators do or should plan and handle ongoing, just-in-time support - particularly during moments of failure. Furthermore, trainings and professional development opportunities for informal educators often include short-term experiences (e.g., two-hour workshop) grounded in traditional-focused lectures that reinforce teaching habits (e.g., transmission of knowledge) [18-21]. We heard similar examples from museum partners on this project who mentioned attending conferences, conference-style workshops on a variety of topics, and lunch-and-learns with other museums [22]. It has been argued that museum educators should be engaged in professional development opportunities that are “in situ” [23-24], encourage questioning, active participation, and experimentation [20, 25], and require a long-term commitment [20].

Through this NSF funded project, we addressed these needs by adapting, implementing, and refining a professional development program for productively attending, interpreting, and responding to youths' experiences with failure while engaged in engineering design challenges in informal learning contexts through video-based reflections. In this presentation, we highlight the potential impact of the professional development on informal educators as we sought to answer the research question: How did a reflective, video-based professional development impact museum educators' professional growth around youths' experiences with failures during engineering design challenges?

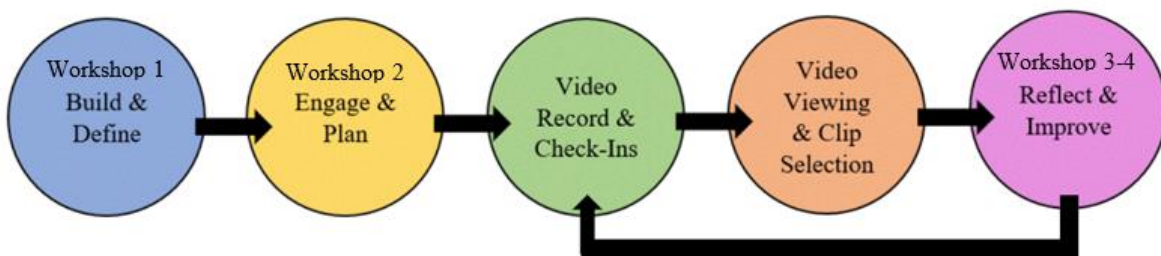
Grounding the professional development program within the intersection of reflection and video recordings of educators was intentional. Reflection is a “a thinking process which gives coherence to a situation which is initially incoherent and unclear” [26, p. 263]. It is also a fundamental practice in numerous fields such as nursing education [27] and social work [28]. While reflection is an emerging practice in informal learning environments [29], research in museum education highlights how reflective practices support individuals in developing a shared language, learning new instructional ideas and strategies [18, 30], and increasing confidence in

facilitating learning experiences with visitors [29-30]. The additional use of video was intended to support museum educator’s noticing of and reflection on experiences that may go unseen otherwise [31-32]. As explained by Sherin [33], “video allows one to enter the world of the classroom without having to be in the position of teaching in-the-moment” (p. 13). Prior scholarship has documented how the process of sharing and reflecting on videos as part of professional development has led to positive outcomes such as educators developing a sense of community through their shared experiences [22, 34], viewing their teaching from a new perspective [35], and gaining different practices to improve their instruction and facilitation of learning opportunities [31, 34-36]. Researchers further noted how video from educator’s own learning environments had greater potential to motivate and promote change in instructional practices as the teaching and learning process was more familiar than watching video from unknown educators [37-38].

Professional Development Cycle

In this project, the professional development model was grounded and informed by the Mathematics Leadership Preparation model to support the professional growth of teacher leaders and the Problem-Solving Cycle model to support the professional growth of practicing teachers [39]. These research-based models incorporate core components of effective PD such as a focus on instructional practices, opportunities to engage with colleagues in an active and collaborative community setting, learning by doing, reflecting on their practice, and ongoing support [40-43]. As noted by Borko and colleagues [39], these two models are adaptable and focused on specific problems of practice identified by teachers. In collaboration with our museum partners, we adapted the model within informal making learning environments specific to supporting youths’ experiences with failure in making tasks. Figure 1 highlights the professional development process.

Figure 1. *Professional Development Cycle*



Workshop 1, Build and Define, aimed to reflect on personal experiences of failure and collectively define failure through an engineering activity and discussion prompts. An example activity used a “Four Corners” exercise that posed the question: What does failure mean to you? This activity asked individuals to take a position on a specific topic, statement, word, or image that represents failure. Once selected, individuals moved to the corner of their choice to discuss their chosen topic in relation to the other three topics, statements, words, or images not selected. Each group then justified their decision to the whole group. Workshop 2, Engage and Plan, focused on exploring failure from the youth’s perspective, especially within the engineering

design challenge that would be the subject of the educator's video reflection. This session also involved brainstorming ways to respond to youth's moments of failure during the challenge, and emphasized effective and non-effective language. One activity from this workshop utilized scenarios that focused on embracing failure. These scenarios were created to discuss what individual educators would do if they experienced a failure situation based on actual events and activities within an organization.

After Workshop 2, educators recorded a minimum of one hour of their interactions with youth during an engineering activity. Subsequently, they reviewed and reflected on the videos, concentrating on how they responded to and addressed failure moments of youth or the particulars when experiencing failure moments as educators. Failure at this point was from the perspective of the educators viewing their video. From these recordings, educators chose 1-2 clips, each not exceeding 3 minutes in length, to present to their peers during either Workshop 3 or 4, Reflect and Improve. The primary purpose of these workshops was for educators to share their video clips with peers, aiming to reflect on their pedagogical approaches to failure as evident in the clips, and to formulate improvement goals. As stated by Gaudin and Chaliès [44], "... simply viewing video does not ensure teacher learning. An important issue concerns how to facilitate substantive analysis of teaching practice with video so that it becomes a productive learning tool for teachers" (p. 59). This was also a workshop to build upon and/or challenge informal educators' perspectives of failure moments and how they often responded in-the-moment. Additional information and resources can be found on our project [website](#).

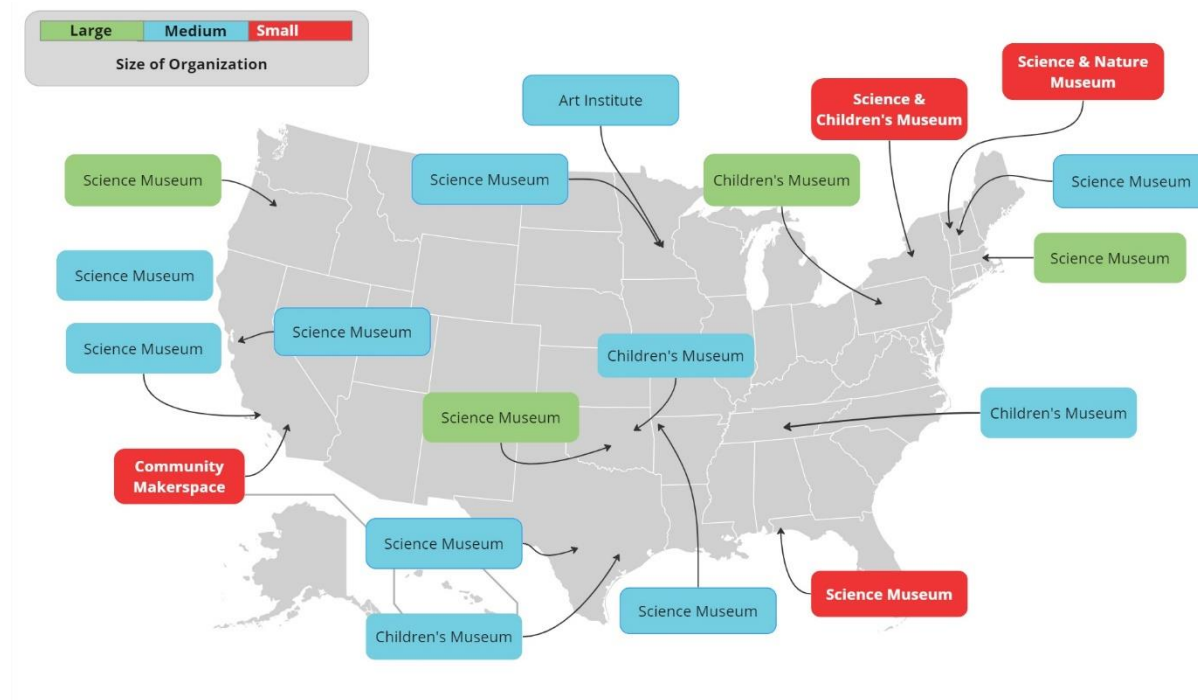
Methods

We utilized multiple data sources from 19 partnering museum sites that spanned multiple regions of the United States: post-interviews with museum sites, final presentations from museum sites, and evaluation reports.

Partnering Organizations

The 19 partnering organizations spanned multiple regions of the United States and also varied in size and focus (see Figure 2). We defined "small" as less than or equal to 10,000 visitors a year; "medium" as between 10,001 to 50,000 visitors a year; and "large" as more than 50,000 visitors a year (Mapping Museums, n.d.). More information regarding the partnering sites and their implementation of the professional development cycle can be found on our project website.

Figure 2. *Map of Partnering Organizations*



Additionally, across the partnering organizations we worked alongside 40 lead facilitators (i.e., teacher leaders). Their role was two-fold: (1) to engage with the research team regarding the development of the professional development cycle and resources specific to their organization, and (2) to implement the professional development cycle with a set of informal educators facilitating an engineering camp, exhibit, drop-in, or workshop within their organization. For example, we worked closely with two lead facilitators at a science museum in Vermont who then engaged with three informal educators through the PD cycle. The focal activity was during a week-long camp during which children in grades 5-6 engaged in the engineering design process through an invention of their own imagination. Across three years of the grant, 98 informal educators engaged in the PD cycle. Within the context of this study, educators span both lead facilitators and informal educators as both groups gained knowledge, skills, and strategies to support their growth as engineering educators of adults and youth.

Data Sources

To address the research question, we utilized three data sources. The first data source was interviews conducted by a research team member with lead facilitators at each partnering site. Interviews occurred after implementation of the professional development cycle within their organization (i.e., September or October). The interviews lasted approximately 45 minutes and were conducted via Zoom. Example questions included: (a) How would you describe your role within the PD cycle? How is this role similar to and/or different from what you would consider your “typical” role with your educators prior to this study?; (b) What have you noticed in terms

of the PD cycle for the informal educators you worked with?; and (c) In terms of the PD cycle, what did you imagine doing the same? What do you imagine doing differently? Why?

A second data source was final presentations given by each partnering site. These occurred in October and served as a final reflection on each organization's experience. Each partnering site addressed the following questions in a 10-minute presentation: (a) What does failure mean to your educational team?; (b) Describe your professional development cycle; (c) What impact did this project have on you, informal educators, educational team, and/or larger organization?; and (d) How did this project change your practices and future goals related to supporting informal educators in attending, interpreting, and responding to youth's failure moments in engineering activities?

Lastly, we utilized annual reports from the external evaluator as she included broad themes as well as direct quotes from educators. These quotes were from focus group interviews that included such questions as: (a) Do you feel that the training you received impacted how prepared and confident you feel in supporting your educators in their growth and development when interacting with learners during moments of failure? Why do you think it had an impact?; (b) What did you gain from the PD training? What are you doing differently because of the training you received? What impact did the PD have on your professional growth as an educator?; and (c) What did you gain from each other as participants during the project team meetings (or during Workshops 3 and 4)?

Analysis

For each data source, we focused on quotes that addressed the research question. Next, we added a descriptive code, a word or phrase that summarizes the primary topic of the quote [45]. We then grouped descriptive codes that were common in nature into patterns that addressed the research question.

Findings

Five patterns emerged that highlight museum educators' professional growth around visitors' experiences with failures from across the data. We note each pattern below and include direct quotes as support. Pseudonyms are included for anonymity of participants. We used italics to connect the included quotes to each pattern.

First, the professional development cycle facilitated a *shift in educators' perspectives on failure*, fostering a greater sense of comfort with the term and encouraging a nuanced understanding of its role in personal and professional growth.

And I think that the thing that stood out for me is just like a *shift in the comfort with the word failure* and how I feel like I could actually help facilitators who have the same gut reaction as me think around that now. (Linda, lead facilitator)

It seems like Kiara's relationship with failure, actually, she's the most positive of them all. And the person who definitely had like, the, what I think she thought of as the right of

view of failure, and like its moment for growth, and like all that in the beginning. And then she's the person that I think at the *end of workshop four had the biggest realization of like her own toxic positivity*. Through this process, *she came to see what does it mean for failure to be an opportunity for somebody to learn and grow from. It doesn't mean that it has to be entirely a positive experience*. (Ophelia, lead facilitator)

Second, educators expressed *gaining new instructional practices* as part of their toolkit when responding to visitors' moments of failure within the engineering design challenge. Broadly speaking, educators "learned new techniques or have more knowledge of what to do in those kinds of situation" (Suzanne, informal educator). This included stepping back to allow productive failure to happen, setting up expectations of failure, posing purposeful questions, and encouraging experimentation and play.

I've definitely *learned to not give them [youth] the solution, but to help them - your job as an educator is to guide them to finding the solution themselves*. I think it's important to not teach them what to think, but teach them how to think. (Grace, informal educator)

There's value in just *supporting the feelings, validating it [failure] and then trying to encourage this idea that it's normal and it's reasonable and it's just gonna keep happening*. So where can we go from here? What's our next step? What can we think about? (Alicia, informal educator)

Recognize that during busy times *short cuts may reduce opportunities for failure*. (Kate, lead facilitator)

Third, engaging in the professional development cycle *fostered a collaborative community of educators*, particularly around supporting visitors' experiences with failure within engineering design activities. Through the process, educators became more supportive of one another and appreciated what they could learn from one another through discussions around the video clips.

In addition to *establishing learning, being vulnerable, and trusting of one another*, it also gave us a *common experience* as a relatively new team to reference. Now staff laugh about something being a failure when things don't go as planned and are more able to move on from those setbacks with more humility and grace than before. (Katie, lead facilitator)

I think that it made us *more cognizant of each other's facilitation styles and what we bring to the table*. ... I feel like I learn a lot from my team members and my team members can also absorb what I bring to the table. I think that it was a *great process to get us all on the same page* and thinking about how we can really make this a really good experience for different guests and different types of learners. (Sonya, informal educator)

Through their shared experience, failure became a common topic of conversation within informal chats between educators. These conversations also expanded beyond the educators and occurred with individuals within the broader organization.

Failure became a common topic of conversation both amongst staff and within camps.
Brittany (lead facilitator)

And then it seemed like it was *more present on people's minds continuously and not just a blip in there*. You know, oh, yeah, I haven't been thinking about that. Let me just read re refresh myself on what that's all about kind of thing. *Like this was an ever-present thing that we were talking about.* (Myra, lead facilitator)

Fourth, educators *reflected upon and invested in their own self growth*. They reported becoming more self-compassionate for their own failure moments, and more open and honest with themselves and learners. They emphasized increased self-awareness and self-confidence, as well as enhanced meta-cognitive skills gained through careful analysis and reflection of their instructional practices around failure moments of both self and visitors.

Gave me courage to *confront my own mistakes*. (Amy, informal educator)

I was able to think *critically about my actions*. Normally I just go about my day and take things as they come without really thinking too hard about them. Now, when I facilitate, I constantly am checking in with myself about the effect of my actions and strategies. In other words, *I am significantly more meta-aware*. (Hope, informal educator)

Seeing the footage and watching myself *makes me empathetic*. It helps me think about how I'm training my team and how I'm setting them up. To be okay in those moments and to have tools to use in those failure moments. (Myra, lead facilitator)

Fifth, educators talked about the *sustainability of the professional development* beyond their participation in the project and continuing to incorporate what they learned as part of their routine practices. They noted enthusiasm for continuing with the professional development activity, integrating what they had learned in other spaces and activities in their museums, and how reflection has become a part of their regular routines.

What was really enlightening from round one was how *interested and engaged our educators were in continuing and they're still asking about when we can continue*. (Kelly, lead facilitator)

In thinking about the new shape of this lab, I really want to *make sure there's room to fail and try again, fail and redesign, as many times as possible*. (Jesse, informal educator)

We plan to integrate failure stories and reflective conversations into our morning huddles with our team, giving the team the chance to talk about experiences, dig into stories from peers, and provide a safe reflective space for each other. (Acer, lead facilitator)

Discussion

Our goal in this study was to explore the impacts on educators' professional growth of engaging in a reflective, video-based PD that focused on supporting youth through moments of failure during engineering design challenges in their spaces. We chose to ground the PD within the intersection of reflection and video recordings as a way to support educators' noticing of and reflecting on moments of failure that may have been overlooked [37]. Such approaches are emerging in the field of museum education and have shown promise in creating a common language and new strategies related to supporting visitors. However, we were cognizant that this approach likely would be new to most of our museum partners and informal educators, and one that would be uncomfortable, at least initially, to engage with. As such, we contend that the significance of this study lies in the potential for a video-based professional development cycle to positively shift how educators support youth through failure experiences in engineering design challenges, as well as build a community of practice - with a focus on failure - among educators.

The results of our analysis are consistent with prior research, yet build upon this body of scholarship as the majority of this prior research was more often grounded in more formal settings (e.g., schools) and focused on students' thinking as opposed to youths' experiences with failure during engineering design challenges [31, 34-36]. First, similar to Grabman et al. [30] and Moore et al. [29], informal educators experienced a shift in their views on failure from a negative perception to one more positive and valuable. Second, informal educators gained new instructional practices through sharing and discussing video clips in Workshops 3-4 [18, 31, 35]. Third, being a member of the PD cycle fostered a community of educators as opposed to thinking of teaching as an isolated phenomenon [22, 34].

In addition, the results of our study add to our current understanding of reflective, video-based PD, particularly for informal educators' interactions with youth through moments of failure during engineering design challenges in their spaces. First, educators developed a sense of compassion regarding their own failure moments. While this is somewhat related to shifts in perspective on failure, it goes a step further and fostered educators putting these changed perspectives into actions, both with themselves and learners. Further, informal educators in this study were willing to be more vulnerable with themselves and with learners, and modelled their newfound perspective. We refer to this as being vulnerageous (vulnerable + courageous). Second, we were intentional about the design of the PD to address limitations of "typical" PD opportunities. These design choices and the use of reflection seemed to resonate with and impact museum educators such that they were motivated to continue with the work as part of their practice. This may relate to the fact that it was done "in situ" with examples from their own spaces with their peers. As noted by Borko et al. [37] and Seidel et al., [38], in situ has more potential to motivate and promote change in instruction and learning.

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References

- [1] P. S. Lottero-Perdue, "Elementary student reflections on failure within and outside of the engineering design cycle," *American Society for Engineering Education Ann. Conf. & Exp.*, Seattle, WA, 2015.
- [2] X. Tian and T. Y. Wang, "Tolerance for failure and corporate innovation," *The Review of Financial Studies*, vol. 27, pp. 211-255, 2014.
- [3] J. Lahey, *The gift of failure: How the best parents learn to let go so their children can succeed*, New York, NY: HarperCollins Publishers, 2016.
- [4] P. S. Lottero-Perdue and M. Tomayko, "Kindergarteners' engagement in an pistmic practice of engineering: Persisting and learning from failure," *American Society for Engineering Education Ann. Virtual Conf. & Exp.*, Montreal, Quebec, Canada, 2020
- [5] E. J. Stretch and G. H. Roehrig, "Framing failure: Leveraging uncertainty to launch creativity in STEM education," *International Journal of Learning and Teaching*, vol. 7, pp. 123-133, 2021.
- [6] A. Jackson, A. Godwin, S. Bartholomew, and N. Mentzer, "Learning from failure: A systematized review," *International Journal of Technology and Design Education*, vol. 32, pp. 1853-1873, 2022.
- [7] J. J. Ryoo, N. Bulalacao, L., Kkelis, E. McLeod, and B. Henriquez, "Tinkering with "failure": Equity, learning, and the iterative design process," *FabLearn 2015 Conference*, Stanford, CA, 2015.
- [8] A. Simpson and A. V. Maltese, ""Failure is a major component of learning anything": The role of failure in the career development of STEM professionals," *Journal of Science and Technology Education*, vol. 26, pp. 223-237, 2017.
- [9] C. M. Cunningham and G. J. Kelly, "Epistemic practices of engineering for education," *Science Education*, vol. 101, pp. 486-505, 2017.
- [10] M. M. Johnson, G. J. Kelly, and C. M. Cunningham, "Failure and improvement in elementary engineering," *Journal of Research in STEM Education*, vol. 7, pp. 69-92, 2021
- [11] H. Petroski, *Design paradigms: Case histories of error and judgment in engineering*. Cambridge University Press, 1994.
- [12] V. Hendley, "The importance of failure," *ASEE Prism*, vol. 8, 19-23, 1998.

- [13] D. I. Acosta and C. A. Haden, "Museum based tinkering and engineering learning opportunities among Latine families with young children," *Journal of Applied Developmental Psychology*, vol. 80, Article 101416, 2022
- [14] Y.-L. Chen, K. Murthi, W. Martin, R. Vidliksis, A. Riccio, and K. Patten, "Experiences of students, teachers, and parents participating in an inclusive, school-based informal engineering education program," *Journal of Autism and Developmental Disorders*, vol. 52, pp. 3574-3595, 2022.
- [15] S. Hug and S. Eyerman, "Instructional strategies in K-12 informal engineering education – Deep case study approaches to educational research," *American Society for Engineering Education Ann. Conf. & Exp.*, Salt Lake City, UT, 2018.
- [16] M. Marcus, D. I. Acosta, P. Tōugu, D. H. Uttal, and C. A. Haden, "Tinkering with testing: Understanding how museum program design advances engineering learning opportunities for children," *Frontiers in Psychology*, vol. 12, Article 689425, 2021.
- [17] L. C. Pagano, C. A. Haden, D. H. Uttal, and T. Cohen, "Conversational reflections about tinkering experiences in a children's museum," *Science Education*, vol. 103, pp. 1493-1512, 2019.
- [18] L. B. Allen and K Crowley, "From acquisition to inquiry: Supporting informal educators through iterative implementation of practice," in *Preparing Informal Science Educators*, P. G. Patrick, Ed. Cham, Switzerland: Springer International, 2017, pp. 87-104.
- [19] B. Bevan and M. Xanthoudaki, "Professional development for museum educators: Unpinning the underpinnings," *The Journal of Museum Education*, vol. 33, pp. 107-119, 2008.
- [20] C. Robinson, "Thoughts on the history of professional development programs in museums," *Journal of Museum Education*, vol. 44, pp. 123-130, 2019.
- [21] L. U. Tran, P. Gupta, and D. Butler, "Redefining professional learning for museum education," *Journal of Museum Education*, vol. 44, pp. 135-146, 2019.
- [22] A. Simpson, A. Anderson, and A. V. Maltese, "The ups, downs, and potentials of implementing video clubs in museums," *Journal of Museum Education*, vol. 48, pp. 306-314, 2023.
- [23] E. W. Taylor, A. C. Neill, and R. Banz, "Teaching in situ: Nonformal museum education," *Canadian Journal for the Study of Adult Education*, vol. 21, pp. 19-36, 2008.
- [24] L. U. Tran, M. Wrrnr-Avidon, and L. R. Newson, "Successful professional learning for informal educators: What is it and how do we get there?," *The Journal of Museum Education*, vol. 38, pp. 333-348, 2013.
- [25] R. S. Grenier, "The role of learning in the development of expertise in museum docents," *Adult Education Quarterly*, vol. 59, pp. 142-157, 2009.

- [26] M. Clara, "What is reflection? Looking for clarity in an ambiguous notion," *Journal of Teacher Education*, vol. 66, pp. 261-271, 2015
- [27] C. Hayes, D. Jackson, P. M. Davidson, J. Daly, and T. Power, "Pondering practice: Enhancing the art of reflection," *Journal of Clinical Nursing*, vol. 27, pp. 345-353, 2018.
- [28] H. Ferguson, "How social workers reflect in action and when and why they don't: The possibilities and limits to reflective practice in social work," *Social Work Education*, vol. 37, pp. 415-427, 2018.
- [29] S. Moore, J. Roche, L. Bell, and E. E. Neenan, "Supporting facilitators of maker activities through reflective practice," *Journal of Museum Education*, vol. 45, pp. 99-107, 2020.
- [30] R. Grabman, T. Stol, A. McNamara, and L. Brahms, "Creating and sustaining a culture of reflective practice: Professional development by and for museum-based maker educators," *Journal of Museum Education*, vol. 44, pp. 155-167, 2019
- [31] H. Hollingsworth and D. Clarke, "Video as a tool for focusing teacher self-reflection: supporting and provoking teacher learning," *Journal of Mathematics Teacher Education*, vol. 20, pp. 457-475, 2017.
- [32] D. M. LeFevre, "Designing for teacher learning: Video-based curriculum design," in *Advances in research on teaching: Vol. 10: Using video in teacher education*, J. Brophy, Ed. Oxford, UK: Elsevier, 2004, pp. 235-258.
- [33] M. G. Sherin, "New perspectives on the roles of video in teacher education," in *Advances in research on teaching: Vol. 10: Using video in teacher education*, J. Brophy, Ed. Oxford, UK: Elsevier, 2004, pp. 1-27.
- [34] J. M. Amador, A. Wallin, J. Deehr, and C. Chilton, "Collective noticing: teachers' experiences and reflection on a mathematics video club," *Mathematics Education Research Journal*, vol. 35, pp. 557-582, 2023.
- [35] T. R. Tripp and P. J. Rich, "The influence of video analysis on the process of teacher change," *Teaching and Teacher Education*, vol. 28, pp. 728-739, 2012.
- [36] E. A. van Es and M. G. Sherin, "The influence of video clubs on teachers' thinking and practice," *Journal of Mathematics Teacher Education*, vol. 13, pp. 155-176, 2010.
- [37] H. Borko, J. Jacobs, E. Eiteljorg, and M. E. Pittman, "Video as a tool for fostering productive discussions in mathematics professional development," *Teaching and Teacher Education*, vol. 24, pp. 417-436, 2008.
- [38] T. Seidel, K. Stürmer, G. Blombrg, M. Kobarg, and K. Schwindt, "Teacher learning from analysis of videotaped classroom situations: Does it make a difference whether teachers observe their own teaching or that of others?," *Teaching and Teacher Education*, vol. 27, pp. 259-267, 2011.

- [39] H. Borko, J. Jacobs, K. Koellner, and L. E., Swackhamer, *Mathematics professional development: Improving teaching using the problem-solving cycle and leadership preparation models*, New York, NY: Routledge, 2015.
- [40] L. M. Desimone, “Improving impact studies of teachers’ professional development: Toward better conceptualizations and measures,” *Educational Researcher*, vol. 38, pp. 181-199, 2009.
- [41] C. J. Dunst, M. B. Bruder, and D. W. Hamby, “Metasynthesis of in-service professional development research: Features associated with positive educator and student outcomes,” *Educational Research and Reviews*, vol. 10, pp. 1731-1744, 2015.
- [42] M. S. Garet, A. C. Porter, L. Desimone, B. F. Birman, and K. S. Yoon, “What makes professional development effective? Results from a national sample of teachers,” *American Educational Research Journal*, vol. 38, pp. 915-945, 2001
- [43] S. Loucks-Horsley, K. E. Stiles, S. Mundry, N. Love, and P. W. Hewson, “Designing professional development for teachers of science and mathematics,” Thousand Oaks, CA: Corwin Press, 2009.
- [44] C. Gaudin and S. Chaliès, “Video viewing in teacher education and professional development: A literature review,” *Educational Research Review*, vol. 16, pp. 41–67, 2015.
- [45] J. Saldaña, *The coding manual for qualitative researchers*