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Integrating Flip in the Science Classroom: A Case Study of an Elementary Preservice Teacher's Learning Through a Coaching Partnership

Nancy Sharfun
University of South Florida

Karl G. Jung
Bradley University

Technology integration has become essential to everyday life in the 21st century. Numerous types of technology tools are now available for science teachers (Guzey & Roehrig, 2009), and teaching and learning involve more technology than ever before. Teachers can stimulate inquiry throughout learning by using technologies, learning management systems, data collection and analysis software, and communication tools, and these technologies support enhanced engagement by increasing effective communication between learners and instructors throughout the learning process (Asim et al., 2022).

Hence, if implemented based on the need of content, topic, and students, technology tools can become a utilitarian tool in students' active engagement in the content being taught and improving their communication and classroom discussion. Much of this technology is the same technology that teachers use in their daily lives, and while they are proficient in using it for daily purposes, there is still a need to acquire expertise in meaningful integration of those tools for enhancing students' learning in the science classroom (Joseph et al., 2010; Lewis, 2015; Ozen, 2013, Williams et al., 2023). Being technologically savvy in everyday life is insufficient to ensure effective classroom implementation of those technology tools, which requires content and topic-specific skills and techniques.

Separating technology from science learning is now considered disadvantageous while the learning environment is undergoing digital proliferation (Asim et al., 2022). For decades, many educators have contemplated the role of technology in science education (e.g., Johnson, 1989; Thornburg, 1999), yet despite this emphasis, many educators continue experiencing difficulty in the functional integration of technology into their instruction (Asim et al., 2022; Hechter et al., 2012; Svihla et al., 2015). Even though access to technology tools in the classroom has expanded, teachers still need support in meaningfully creating relevance and appropriately using these tools with the content being taught.

Multiple scholars (e.g., Emre, 2019; Ertmer et al., 2012) have noted that external barriers, such as lack of resources, time, opportunities, and funding, still impede technology integration; however, the main factors at play are teachers' beliefs and confidence level in technology integration. Moreover, through our work with both in-service and preservice teachers, we have seen many teachers struggle to incorporate technology in authentic and meaningful ways to support science learning.

A lack of understanding of the functionality of devices while failing to spend adequate time learning to implement the technology (Minshew & Anderson, 2015) are possible reasons for the lack of confidence and quality in integrating technology-enhanced teaching and learning strategies. Teachers require support and guidance in successfully incorporating technology tools meaningfully into their teaching strategies (Constantine & Jung, 2019). This is true for teachers at all points in their careers, and preservice teachers must be equipped with the skills to effectively implement technology tools in their classrooms to support science learning.

Unfortunately, while many preservice teachers have attended school in an era when technology was becoming increasingly ubiquitous in schools, they still lack confidence and are hesitant to include technology in their classrooms (Kimm et al., 2020; Lewis, 2015; Williams et al., 2023). These barriers to technology integration provide the impetus for exploring further how teachers can plan and learn to support student learning with technology tools, specifically at the preservice level. Documenting teachers' experiences with technology-enhanced teaching can provide possible avenues for successfully implementing such tools.

Guiding Literature

Teacher Learning of New Technologies

Gone are the days when technology use in science classrooms meant watching a video, accessing information, or viewing slides on a microscope. The proliferation of digital technologies in many citizen's daily lives and in schools has driven a shift to students' actively using technologies to deepen their science conceptual understanding and to communicate that understanding through numerous mediums. Students now produce images, videos, and recordings, collect data, and critique ideas using a myriad of devices, apps, and platforms. Failing to include

such tools in science classrooms disadvantages students in their engagement in and learning of science content (Asim et al., 2022).

Utilizing digital technologies has been linked to several benefits in the science classroom, including improving student learning outcomes and student attitudes (Hillmayr et al., 2020), supporting student involvement in knowledge construction, and improvements in thinking and problem-solving skills (Guzey & Roehrig, 2009; Trowbridge et al., 2008). However, the benefits gained from technology are highly dependent upon how teachers integrate technology into their instruction and the methods and strategies they use to support student science learning (Hillmayr et al., 2020).

One framework that examines how technology is used in the classroom is the PICRAT framework (Kimmons et al., 2020). This framework, built on the previous work of Hughes et al. (2006), provides a helpful guide for technology integration in science classrooms that will support meaningful teaching and learning of science content. It aims to provide a model for teachers and teacher educators that is "student-focused [and] pedagogy-driven" (Kimmons et al., 2020, p. 184), and has been used in science classrooms to examine the implementation of digital science notebooks (Constantine & Jung, 2019).

Two main aspects make up the framework that allows for the examination of student relationships to technology (PIC) and the ways teachers use technology in relation to traditional instructional practices (RAT; Kimmons et al., 2020). As students engage with technology in the classroom, the PICRAT framework describes that relationship as occurring in one of three manners: passive, interactive, or creative.

The second portion of the framework (RAT) looks closely at how teachers use technology in the classroom in relation to traditional or typical classroom practices and whether this implementation takes one of three forms: replacement, amplification, or transformation. The hope is that when technology is implemented within classrooms, students will move from more passive to creative means of interacting with the technology and that teachers will use it to amplify or transform learning activities instead of simply replacing the medium through which students are learning.

For the myriad of available technologies to be used to realize the vision of technology integration forwarded by the PICRAT framework and meaningfully support student science learning, teachers must have a firm grasp of how to utilize those technologies as a part of their instruction (Sprague et al., 2023). The use of technology in science classrooms has been examined significantly over the previous decades (Asim et al., 2022), yet even with these continued examinations, there seems to be an ever-present need to understand how new and novel technologies are utilized within classrooms and how those technologies support student engagement with, and learning of, science content (Higgins et al., 2012).

Compounding this ever-changing set of technologies available in the classroom is the fact that to effectively support learning more than technical competence with the technology is needed. Teachers need to

understand how to use the technology pedagogically within the classroom for it to have a meaningful impact on the learning and understanding of students (Ertmer et al., 2012; Hillmayr et al., 2020; Lindstrom et al., 2021; Ottenbreit-Leftwich et al., 2010), and this understanding for teachers should begin during preservice education programs.

Unfortunately, preservice science teachers continue to need support in integrating technology tools in their science instruction (Hechter et al., 2012; Sprague et al., 2023). They are not receiving the required guidance and knowledge to integrate technology in their classroom, even though they have significant experiences with many of the technology tools from social and out-of-school situations (Sprague et al., 2023). As such, different models must be explored for supporting teachers in developing their understanding of how to use technologies pedagogically in support of science instruction. This study sought to build on this area of need by exploring the learning of one preservice science teacher as she engaged in a coaching partnership that focused on her use of a specific technology.

Coaching to Support Technology Integration

For preservice science teachers (PSTs) to learn how to implement new technologies to bolster student science learning effectively, they need to be supported in exploring and understanding these technologies. One strategy that could be beneficial in this learning for PSTs is using coaching partnerships focused on developing their skills. Coaching partnerships seek to improve teaching and learning through focused, supported time examining teaching practice, teacher thinking, and student learning (Knight et al., 2015). In these partnerships, coaches and teachers often work together to design, implement, and reflect on new instructional actions while collaboratively navigating challenges that arise through the work (Knight, 2007).

Numerous coaching models are utilized to support teacher learning (e.g., Gibbons & Cobb, 2016; Knight, 2007; West & Cameron, 2013), and research on coaching has shown positive impacts on teacher development and instructional practice (Kraft et al., 2018). However, much of the work around coaching has focused on mathematics and literacy instruction and primarily has been conducted with in-service teachers. Therefore, additional work in coaching that focuses on science instructional settings and preservice teacher learning of new instructional technologies is warranted.

Our previous work has examined a coaching partnership in a science classroom (Constantine & Jung, 2019). In this work, we examined a teacher's experiences in implementing digital science notebooks through a one-to-one iPad initiative and the ways the teacher's use of this technology evolved over the course of the coaching partnership. Findings from this study showed that the coaching partnership provided dedicated time for the teacher to focus on developing and refining the digital science notebooks and supported the teacher in addressing new ideas, challenges, and issues that arose throughout his exploration of the technology. We concluded that this dedicated time provided by the coaching partnership was essential to manifesting the elementary science teacher's vision for digital science notebooks in his classroom.

The coaching partnership explored in the current study was grounded in Knight's (2007) Instructional Coaching model and the partnership approach advocated in that model. Instructional coaching seeks to support teachers in growing their practice by focusing on the teacher's goals in either behavior, content, direct instruction, or formative assessment, and leverages the partnership philosophy to create effective coaching conversations. The partnership philosophy is built on seven principles: equality, choice, voice, dialogue, reflection, praxis, and reciprocity. These principles (Table 1) are designed to allow teachers and coaches to enter conversations as partners, where they collaboratively explore and reflect on the areas in which the teacher is interested in improving related to their practice. Coaches and teachers learn with and through each other as they investigate that practice through conversation, observation, and modeling.

Table 1
Instructional Coaching Partnership Principles (Knight, 2007)

Partnership Principle	Overview of Principle
Equality	"Instructional coaches and teachers are equal partners" (p. 40).
Choice	"Teachers should have choice regarding what and how they learn" (p. 41).
Voice	"Professional learning should empower and respect the voices of teachers" (p. 43).
Dialogue	"Professional learning should enable authentic dialogue" (p. 46).
Reflection	"Reflection is an integral part of professional learning" (p. 47).
Praxis	"Teachers should apply their learning to their real-life practice as they are learning" (p. 49).
Reciprocity	"Instructional coaches should expect to get as much as they give" (p. 50).

While embodying and honoring all seven partnership principles is essential to instructional coaching partnerships, our previous work (Jung, 2020) has identified that when a university faculty member coaches preservice teachers embodying these principles is only sometimes possible. The difference in power and positionality that exists between faculty members and students completing coaching as a requirement of their teacher education program limits the ability for equality and reciprocity.

Because preservice teachers are implementing their lessons within another teacher's classroom, their ability to choose what they are teaching and focusing on in their instruction is somewhat diminished (Jung, 2020). As such, *v*oice, dialogue, praxis, and reflection were the principles at the foundation of the coaching partnership presented here, with the principles of equality, choice, and reciprocity taking a reduced focus in the partnership.

Flip

As an increasing number of young people are using Web 2.0 technologies to interact and make social connection or to express their thoughts and opinions, technology use among 21st-century students is much more widespread than before (Schuck & Aubusson, 2010). Over the past 15 years, Web 2.0 technology has emerged and includes the wide range of user-controlled publishing and networking websites. These sites have created opportunities and platforms for social networking, where people can share and express themselves.

These platforms have also been leveraged for educational purposes, with uses across the K-12 and university spectrum. One such platform that has seen significant growth in recent years is Flip (www.info.Flip.com). Flip, an online tool that allows teachers to ask questions by creating what the tool refers to as "grids" to facilitate video discussions for students, acts as a social learning platform where students can upload their responses to a discussion topic provided by their teacher and respond to the posts made by their classmates. Accessible by using cell phones, tablets, or computers, Flip can assist classroom instruction and assessment by allowing teachers to manage discussion activities and giving students opportunities to respond verbally to topics in a grid (Flip, 2018).

The hope in utilizing Flip in the classroom is that the features support students in maintaining and increasing their engagement in classroom discussions while providing substantive responses to communicate their learning. This expectation is supported by McLean's (2018) study, which found that students were more comfortable and more expressive when using Flip than when writing responses in the classroom. Voorn and Kommers (2013) contended that introverted students are more likely to communicate via social media than in person. Therefore, using Flip in science classrooms may support teachers in gaining a more complete view of students' learning and understanding.

Research Question

This study sought to understand how a beginning elementary teacher explored Flip within her student teaching placement and how that implementation evolved over a semester as she began applying it for assessment purposes with her third-grade students. The following research question guided this study: In what ways did a preservice elementary science teacher learn to use Flip in the science classroom through her engagement in an instructional coaching partnership?

Design

This study utilized a single case study design (Yin, 2014). The case for this study consisted of a single teacher who engaged in an instructional coaching partnership with the second author. Utilizing this methodology allowed for an in-depth exploration into one elementary PST's use of the online tool Flip to support her assessment of her students' science learning, as well as how her use evolved over the semester while engaging in the instructional coaching partnership.

Context and Participant

The PST who participated in this study, Maggie (pseudonym), was in the final semester of an undergraduate elementary teacher residency program at a large Southeastern university. The teacher residency program engaged PSTs in significant time in clinical placements within Title 1 elementary schools. For her final internship, Maggie was placed in a third-grade classroom. Maggie had taken the elementary science methods course during the previous semester with the second author (henceforth referred to as Dr. Karl), and during the final semester, that was the focus of this study, she was engaged in a science-focused instructional coaching partnership. During this coaching partnership, Maggie and Dr. Karl met every other week while working on a specific instructional goal for the semester. On weeks when she did not have a coaching meeting, Maggie taught, video recorded, and reflected on lessons using the online learning platform Edthena. The coaching meetings focused on discussing lessons from the previous week and Maggie's progress toward her selected goal, as well as planning for upcoming lessons and continued implementation of instruction related to her goal.

Data Collection and Analysis

Data for this study were collected from multiple sources. The primary data source in this study was the audio recordings of the science-focused coaching conversations between Maggie and Dr. Karl. The coaching partnership, a requirement of the teacher residency program, was built on Knight's (2007) partnership principles and sought to support the PSTs in developing their content knowledge and practices in teaching science.

Across the semester, each conversation followed a similar but open format to discuss the science teaching and learning that was taking place in their placement classrooms. Conversations typically began with discussions and reflections on the lesson that had been taught the previous week and the progress toward their identified goal, followed by discussions of upcoming science content, the lessons that would be taught to engage students in that content, and ways the learning thus far related to their goal could be revised and applied to those lessons. The first and final conversations of the semester took a slightly different format, with the first conversation beginning with goal setting for the semester and the final conversation including broader discussion and reflection on science teaching. In total, six coaching conversations took place during the semester, each audio recorded and transcribed.

Between coaching conversations, Maggie implemented lessons with her third-grade students in her placement classroom. These lessons were video recorded and uploaded to the online learning platform, Edthena. Once uploaded on that platform, Maggie would utilize the features of Edthena to reflect on her lesson, focusing on her science teaching, the ways it supported student learning, and the specific actions she took related to her goal. These videos of her classroom instruction, reflections via Edthena, and her written lesson plans served as additional data sources to support the analysis of Maggie's implementation of Flip in her classroom.

To complete the analysis for this study, several systematic steps were taken. To begin the analysis, the first author conducted an episode-by-episode initial analysis (Cobb & Whitenack, 1996) of the coaching conversations by listening to the audio recordings and identifying instances where Maggie and Dr. Karl discussed her use of Flip for formative assessment. A content log (Jordan & Henderson, 1995) was created of each recording that captured a timestamp from the recording, the context of the conversation at that moment, and if applicable, an analytical memo that described why this section of the recording might be beneficial or interesting for the research as well as initial preconceptions of the data.

After completing this initial analysis of all recordings, the exchanges in which Flip was discussed were identified, and the transcripts of those exchanges were compiled. In total, 16 key exchanges, ranging from approximately 1 minute to over 12 minutes across the six coaching conversations were identified and cataloged for analysis. We then utilized these key exchanges and the videos of Maggie's instruction to develop a description of her implementation of Flip in her classroom while participating in the coaching. This temporal view supported our understanding of how her thinking and actions in the classroom changed as she gained experience with Flip and engaged in the coaching partnership.

Finally, the entire data corpus was examined, and a detailed case description was written to describe Maggie's learning around using Flip in the elementary science classroom. This detailed case description served as the basis for the findings presented in this article.

Dr. Karl's Approach to Coaching

The coaching conversations and my approach to coaching was framed by Knight's (2007) partnership philosophy and York-Barr et al.'s (2016) work on reflective practice. When facilitating conversations with my preservice teachers, I aim to honor Knight's (2007) partnership principles as much as possible, recognizing that this is only so possible with the power and positionality that exists within this coaching that was required as a part of the teacher education program. The principles of *voice, praxis, dialogue,* and *reciprocity* were the four I focused on honoring by providing PSTs with space to openly discuss their thoughts and perspectives, focusing conversations on their learning and practice, having an open dialogue in which we were both comfortable sharing our thinking, and learning with and through the PSTs as I understood the realities of their classroom. Through this work I supported the PSTs in reflecting in multiple directions (York-Barr et al., 2016) both backward on their previous instruction as well as forward on their upcoming lessons.

Within this approach, I took on numerous roles and utilized multiple coaching moves (McFadden & Roehrig, 2020) to support Maggie in her reflection, critical thinking, planning, and building understanding of her teaching and how it was impacting her lessons and student learning. My goal for the coaching conversations and the work with Maggie and her classmates was to instill a practice of reflection and a confidence in their ability to engage elementary students in science learning. The aim was

never to enter into the conversations with Maggie by telling her what she should be doing, or how she should be teaching the lessons, but instead to allow her the space to develop her own ideas and support her in thinking through how they would/would not (and did/did not) work with her third-grade students.

Findings

The following sections present the findings regarding the ways Maggie learned to implement a novel technology tool, Flip, in her student teaching placement with the support of her science content-focused coach, Dr. Karl, to understand its utility in supporting elementary students' science learning. We present a rich case description of her interactions in the coaching partnership, her implementation in the classroom, and her reflections on her instruction to demonstrate her initial thinking around using Flip and how that thinking evolved as she implemented it over the course of the semester. For consistency, throughout the findings presented here, we modified any references to Flipgrid in evidence quotations to the current name of the platform, Flip.

Flip for Student Engagement as Initial Thought

At the beginning of the final semester coaching partnership, Maggie and Dr. Karl collaboratively met to begin the coaching sessions and identify directions and goals for her to work toward over the course of the semester. To initiate this goal setting, Dr. Karl asked Maggie what she felt she wanted to work on during this semester. Providing choice and voice are essential components of instructional coaching partnerships and allowed Maggie to set the directions for the semester afforded her these elements.

After a moment of reflection, Maggie determined that her goal was to focus on building and maintaining her students' engagement throughout the 5E phases in her lessons and units. Specifically, she was interested in focusing on the Explain phase, while identifying what factors or activities were more engaging for her students. Maggie said her students were generally enthusiastic about activities and noted that they were engaged early in the lessons; however, when instruction shifted to discussions, such as after reading a classroom article, their engagement diminished.

She shared a specific example from a recent lesson in which the students were designing parachutes and exploring gravity:

> These past two weeks we've been doing parachutes. So, the kids had to build one with the slowest rate that hit the target. Our first day was just talking about NASA and the sounding rocket and the payloads and all that. And the kids thought that was really cool. I was like, "NASA called us. They want us to help them with this." And so that engaged them. But then I felt like, as they were building, that they were engaged, like designing and building. But then yesterday, we sat down to talk about gravity (after reading an article), because that was the standard. And I just don't think that was very engaging. (Conversation 1)

Dr. Karl asked her to expand on her thinking. She said she wanted her students to be actively engaged with the content being taught. She noticed from her experiences that achieving this type of initial engagement with a topic was easier than maintaining that same effort and engagement from the students throughout the lesson, especially when the topic required deeper understandings and discussion.

Maggie also described difficulties she experienced in maintaining student engagement with traditional assessment activities. These assessments included activities such as workbook activity pages from the district purchased science curriculum, which simply required students to write one- or two-word answers to questions, or exit tickets where students wrote short responses to a prompt, were failing to meet the levels of engagement Maggie wanted to see. As a result, Maggie believed students were not providing sufficient evidence of their learning related to the content for her to have a clear picture of how they were progressing. She wanted to try an alternative method for these activities through incorporating technology:

> Just having them in a Google doc or something where they can go into that and type it. Maybe just having the opportunity to be on the laptops again in science would bring that engagement instead of writing one-word answers in their notebook. (Conversation 1)

At this point, Dr. Karl offered an additional possibility for a technology tool she could use with her students that might support some of the challenges she described.

> You could get yourself set up on [Flip]. They could use that, which would allow them to just explain it then, and articulate it verbally and wouldn't have write it into sentences, which we know, generally for kids, they can usually say it before they can actually write it, right? As students' progress, we know that. So, I mean, that could be an option. (Conversation 1)

Flip was suggested by Dr. Karl because it was a tool that Maggie was familiar with, having utilized it as a learner weekly during her science methods course the previous semester. He believed that implementing this tool in the classroom might improve student responses, as it did not require students to write responses. They could, instead, verbally articulate their ideas, likely an easier task to accomplish for Maggie's third-grade students.

Flip was presented as an option for Maggie to consider and potentially use, allowing her to exercise choice in her learning. Following this conversation, Maggie decided to integrate Flip into her lessons and activities and began planning to use it to support her student's engagement in their learning.

First Attempt: A False Start and Reflection

The remainder of the first coaching session focused on preparing for Maggie's next science lesson. In this lesson, students explored how

telescopes allow scientists to see more stars in the nights sky. After participating in an activity, Maggie provided her students with a Flip prompt. This was the first time she implemented Flip in her classroom, and unfortunately, it was largely a false start for her and her students, as the activity did not go according to plan.

The first challenge came because Maggie failed to check the classroom computers prior to the lesson and discovered during the lesson that several computers would not connect to the camera or the microphone for students to record. Others did not seem to work with Flip at all, even though Maggie tried to troubleshoot in the moment. These initial technological issues prevented most students from completing their task with Flip, with only a few students completing the Flip that day and a couple more finishing it the next morning.

When Maggie and Dr. Karl met to debrief this lesson, they discussed these struggles to support Maggie in having a more successful implementation in her next lesson. Maggie recognized that she should have taken time prior to the lesson checking the laptops to ensure that the Flip interface worked for the students. "I wish I would have gone through them before and, like, signed into each laptop and figured out which ones did [work]" (Maggie, Conversation 2).

Beyond these technological issues, there were also challenges that resulted from the implementation of Flip in the classroom. Maggie's students struggled in navigating the Flip interface in ways that she had not anticipated, and her instruction in many ways did not provide enough support for students accessing Flip for the first time. During the coaching conversation, Dr. Karl asked Maggie to reflect on her implementation, with the goal of encouraging her to recognize these challenges and ways that she could have approached the instruction differently to better support her students: "Tell me about why you did it that way and do you think you could or should have done it differently or how it went?" (Conversation 2).

During her implementation, Maggie demonstrated how to access and use Flip, while students followed along at the same time on the computers they had at their desks. As she reflected on this implementation, she recognized that simply getting to the website was challenging for the students, as it was not readily available. Students were required to type in the web address into the search bar to reach the site. "So, I knew that [Flip] wasn't something on their homepage, so getting to the website was going to be difficult" (Maggie, Conversation 2).

When introducing the tool to the students, she described the procedures of logging in, accessing a grid, and recording videos; however, her students experienced confusion around a number of aspects of navigating the interface. Students struggled with logging into Flip "even though it's their [regular] computer log in" (Maggie, Conversation 2) and were confused about which grid to click on and how to enter the grid code to access the assigned prompt to complete their response.

This was the first time her students utilized Flip, and their struggles led to many students requiring individual instruction to input their ID numbers

and codes for the assigned grids and access the appropriate prompt. While reflecting on this lesson to her coach, Maggie noted, "They seemed to enjoy the idea of doing it. I think they just need a little bit more practice" (Conversation 2). Dr. Karl pointed out that these challenges likely arose because students were required to follow five individual steps to log in to Flip, followed by navigating to the correct grid for them to answer their prompt. He offered a suggestion to help Maggie understand how she might have implemented Flip differently to prepare her students to successfully utilize the tool:

> It was the first time that this had ever been introduced, and I was wondering if maybe you should have just modeled it completely for them, without them having the computers and getting onto it yet? … Pull them all together, and say, "Great, we're going to try this new tool, and let me show it to you. It's called [Flip] and here's how you get in." And [do this while] showing them with it up on the screen, and then model how you record [a response], sort of like what I did the first time when I introduced it in [our] class. "Here, you click this button and now we record." And actually, show them [the process of] recording a video. I'm just wondering if that would have worked better. That's certainly a different way to do it, given that it's a brand-new tool. (Conversation 2)

In offering this suggestion, Dr. Karl hoped that Maggie would recognize that her introduction of the tool was likely not structured enough for her third-grade students, leading to many of the challenges in the classroom. While many elementary students are familiar with technology and utilizing computers, accessing a new website that is not readily available on the computer homepage poses a challenge, something Maggie noted but had not explicitly planned for. A more structured modeling of how to access and use the tool might have supported her students in utilizing it to share their science understandings.

Setting New Strategies Following Reflection

Following the second coaching conversation, Maggie implemented Flip in her next science lesson, this time with a lesson focused on radiant energy and how that energy warmed the Earth's surface. When reviewing the video recording of her instruction, it was clear to her coach that she had reflected on her initial experience implementing recognized areas where students needed additional support. She also further explored to familiarize herself with the Flip interface.

During this second implementation, Maggie made several changes based on the conversations that she had with her coach, and these changes supported her students in using Flip and recording their responses. As a result, her students were much more successful in navigating the Flip interface. She purposefully provided step-by-step instructions for using the Flip app on the board for the students and described these changes during the coaching conversation that followed her lesson:

> So, I put the website URL on the board and they were able to type that in, and it took them to the correct page, so then we didn't have

> to fight with all of that because they would've gotten upset with that. I wrote the code on the board and their student number so that if a student was a little bit slow putting that information in, the rest of the group could continue to work, and they could go back and still see what they needed to do. (Maggie, Conversation 3)

Dr. Karl reinforced the changes she made in her lesson, emphasizing how clear it was that she was purposeful in her implementation and explanation of Flip during this lesson:

> I really appreciated, in watching your video how, even though you've done [Flip] now, this was the second time, you still were very purposeful of step by step. "Type this in," info.[flip].com, or whatever it was. And then you sort of waited to make sure everyone was there and then moved on, and it will take a few times [of doing it this way because] they're not doing it every day, for them to get to a point where you can just sort of say, "You know what to do. Here's the info at [Flip], here's the grid code. Get yourself in. This is our question. Go." And they'll just go. But I appreciated that you were still sort of purposefully, slowly going through getting them on, and then once they were on, it seemed like they were able to just kind of go [and respond to the prompt]. (Conversation 3)

As she spent more time familiarizing herself with the Flip interface, Maggie discovered that students were unable to see the question/prompt once they started filming their video, which she recognized might cause challenges for some students in remembering the prompt they were responding to. She explained, "And then I gave them a piece of paper with the questions on it because the way it does it on the laptop on theirs, they can't see the question and film" (Conversation 3). She felt this change was successful because the students were able to refer to the question while recording their video. Her coach complimented her recognition of this issue and the solution that she came up with and encouraged her to continue playing "with it from the student end and try to see if you can figure it out" (Conversation 3).

Maggie also began exploring a new use for Flip in this second lesson, recognizing its potential utility for formative assessment and began working toward using it for this purpose with her students. After her coach asked her what she was doing with the videos, Maggie said that she had created a rubric to accompany this Flip post. For this first assessment, she focused on the students' completion of the post, not on the science content they were communicating, as the tool was still new and they were gaining experience and expertise in recording their videos:

> I took more from an angle of we're still kind of practicing doing [Flip], so I was more, because they were doing it with a partner now, more concerned with are they both getting an opportunity to answer it. So, it was their voice, that they needed it to be clear, speak clearly or I can't grade it. They both had to answer the questions and they had to answer the question fully. It had to hit each part of it [the prompt]. (Conversation 3).

Maggie said that going forward her hope was to use Flip for the actual unit assessments and for assessing their science content learning. For this first assessment, however, it was enough for her to make sure that they were responding to the prompt and utilizing the tool correctly because it was so new to the students.

In reflecting on Flip as an assessment tool, Maggie and Dr. Karl realized that because of the way she had created her grid and the settings she had selected, her students were unable to view her feedback. They discussed how she could provide that feedback while still ensuring that her students' videos were private and secure. Dr. Karl encouraged her to reflect on how she could provide her students with the feedback and offered an idea.

> You'll want to think about how do you communicate the feedback? Maybe you either print them off [directly from Flip] or you print off for yourself whatever your rubric is, and as you complete it on [Flip], you quick write their names and then you give, 5-3-1, or whatever, and then you can just pass those slips out and maybe a little note, like, "I really liked how you and your partner took equal turns in this," and then they get that feedback. Or, "Next time try to speak more clearly," something like that, so that they're getting that feedback because, yeah, I think that'll be important particularly as you then start to shift towards content. "Oh, you're really getting this idea about the sun's heat, but we missed this piece," or something like that. (Conversation 3)

This suggestion was made because of the important role that feedback plays in supporting student learning and the need for students to receive feedback from Maggie on how they are progressing, either with completing the Flip posts or eventually with understanding the science concepts.

Between the third and fourth coaching conversations, Maggie did not implement a new Flip prompt, and the fourth conversation then focused on preparing for her next use of Flip. In her next lesson, Maggie said that the students would be finishing up their work on structures and functions of plants and that she would be providing them with a Flip asking, "How do plants use sunlight, air, and water to make food for plants?"

In discussing this prompt and lesson, Dr. Karl asked Maggie how she planned to assess the students' responses to the prompt. Maggie said that she was planning to do it "with the rubric on [Flip] again." Dr. Karl asked for clarification: "But what are you looking for?" (Conversation 4). Maggie explained that she hoped her students would connect to the ideas they had discussed about how plants make food and "that it's being made in the leaves…it needs sunlight to make sugar" (Conversation 4). She would be putting that information into the rubric on Flip to help her in assessing her students. This assessment was a shift in Maggie's use of Flip, as she was now using the Flip rubric to assess students' science understandings and not simply their completion of the prompt. This use aligned with the changes discussed during previous coaching conversations.

Following her implementation of the Flip about how plants make their food, Maggie and Dr. Karl met to discuss how her students did and their understanding of the content. Maggie said that the students were "pretty

flimsy in their thinking" (Conversation 5) and that they seemed to miss the aspect that plants produce sugars that are then used for growth. The students "were getting that the food is made in the leaves" but were not able to describe that what is produced in the leaves is sugar. She noted that they "need to review it," recognizing the need for additional learning to support the students after reviewing the student responses to the Flip.

Future Plans

Unfortunately, the onset of the COVID-19 pandemic disrupted Maggie's progress in implementing Flip with her elementary students, as instruction shifted to fully virtual settings, and her role as a student teacher in planning and implementing lessons changed significantly. As such, Maggie and Dr. Karl held one final coaching conversation at the end of the semester, following 4 weeks of virtual instruction.

Because instruction was extremely different with the sudden shift to online teaching, this conversation focused on reflecting broadly across the previous semester, as well as considering future instruction in her own classroom. When asked about her progress toward her goal, Maggie was pleased with the use of Flip within her classroom and felt that it supported her in improving student engagement across her lessons. She also believed it could be a valuable tool for assessing her students' science learning; however, she would need to ensure that her students were truly comfortable with the tool before using it to assess their science understanding. Until that comfort level was reached, she felt Flip's utility as an assessment tool was limited.

> Some of the kids were ready to have it used as an assessment piece, because they were hitting all the marks, and it was really concise and easy to follow them. Where some of my kids weren't necessarily ready to really be vocalizing their thoughts. … To me it felt like grading them on something where I knew they weren't one hundred percent comfortable using it wasn't fair to them, because I wouldn't want to be graded on a platform that I didn't have a lot of experience with and didn't feel comfortable in. (Conversation 6)

Using Flip for formative assessment would require ensuring participation of all students on Flip, and this hesitation, coupled with the confusion some students experienced because they were not familiar with the tool was something that would take time. She reflected on this progress:

> I think we were starting to make a lot of progress in that evaluation phase with [Flip]. I think if our kids had a little bit more time, they would have really gotten into a routine with it, and [I] would have been able to use that really as their assessment piece. (Conversation 6)

Over the semester, while many of the students were able to provide answers in a way that could be used as assessment piece, some students were not yet comfortable enough vocalize their ideas and chose instead to hold their written answers in front of the Flip video.

However, even given these challenges, Maggie was undeterred and described her desire to use Flip more in the future with the students in her own classroom and even with the kindergarten students whom she was hoping to be able to teach:

> I think those kids would pick up on it quickly just because they're so digitally immersed now at that age. So I think they would pick up on it really quickly. I'd be interested to see how that plays out with them. (Conversation 6)

Maggie described plans for using Flip in the future for her class in several different ways, especially focusing on students who were reluctant in using the tool. Although some of the students showed advanced ability in using Flip even in their assessment phase, others needed more guidance. She explained how the alternative ways of creating their responses could be useful, such as by asking the students to write their answers or draw their ideas onto a piece paper and displaying those in their recording or having students record in pairs.

She was hopeful about her future endeavors using Flip for formative assessment because students are so adaptive at using such tools as they are digitally immersed. She also expressed her intention of using it more frequently in her class so that students would become quickly acquainted with using the tool. She noticed her students were more engaged and involved in the class when they were instructed to record a Flip video, which encouraged Maggie to continue using it in future.

> Even when we did the rotations where some of them were filming and the other ones were doing review work, they were a lot more engaged in that review work, too, because they knew, I get to go do this [Flip] when I'm done with this. I have this opportunity to do this. It's a little bit more, in their eyes, fun. So, I think that helped there. (Conversation 6)

However, Maggie also expressed that more intentional planning would be helpful in using Flip for her formative assessment process. She described a need to plan and align activities and recordings in Flip, so that students had the opportunity to learn their science content effectively and demonstrate that learning using Flip.

> So, I think I could have prepared that sooner with the discussion questions and those responses that I wanted them to get to. And if they weren't quite getting there, what we could have done differently to help support them in that learning. (Conversation 6)

Keeping this in mind, Maggie wanted to plan her future classes to include Flip in a structured way that enabled each student to participate according to their ease and comfort level.

Discussion and Conclusions

In this study, we explored how a preservice science teacher learned to implement a new technology tool, Flip, in her elementary science

classroom through her engagement in an instructional coaching partnership and sought to understand the affordances and challenges of the technology tool. We examined Maggie's step-by-step implementation of Flip throughout a semester to see how she learned to make use of Flip to support student engagement and her instruction, as well as exploring the interactions with her coach around using this tool to support student engagement and learning.

Findings indicate that through her participation in the coaching conversation Maggie was transitioning to a more successful application of Flip before her progress was ultimately halted due to the onset of the COVID-19 pandemic. As Higgins et al. (2012) noted, there is a need to explore, not simply whether technology is used in the classroom, but rather how it is used and whether it truly supports teaching and learning. Our study sought to address this need by examining Maggie's exploration of Flip and how she utilized it within the classroom, as well as understanding the interactions in the coaching partnership and the influences it had on her work.

During the coaching meetings, Maggie developed plans for ways to use Flip in her classroom, initially conceptualizing its use to increase her students' engagement and later transitioning to exploring how it could support her in formatively assessing their learning. The rich, reflective discussions with her coach focused on her instructional planning and helped her transition to utilizing the tool more purposefully in her instruction. After each meeting, applying her experiences alongside her instructional coach's feedback, she modified and made changes in the implementation of Flip to support student engagement.

As the coaching partnership continued through the semester, Maggie transitioned from focusing on student engagement to using Flip as a tool to formatively assess her students. This transition came after she described difficulties in assessing her students through more traditional techniques, such as written work. Students were less responsive to those assessments, and she believed her students might be more engaged in assessments that utilized technology. Maggie began exploring Flip as a tool for assessment and was on the path to using it to directly assess student content understanding after initially focusing her assessment practices on student use of Flip and the videos they created. Unfortunately, the transition to virtual learning with the onset of the COVID-19 pandemic interrupted this progress. Maggie noted in her final reflection, however, a desire to continue exploring Flip for formative assessment as she transitioned into her own elementary classroom.

Previous studies have indicated teachers' struggles in aligning science or STEM (science, technology, engineering, and mathematics) teaching practices with their vision of technology integration (Constantine & Jung, 2019; Constantine et al., 2017; Herschbach, 2011; Wang et al., 2011), and the guided coaching discussions supported Maggie in making practical goals and progress toward classroom implementation of a new technology. Maggie and her coach planned, discussed, and modified instructional strategies each week, as well as analyzed classroom videos to improve her technology tool implementation. Such guidance allowed her to have substantial support and feedback and space for improvement.

Additionally, her interest and exploration of Flip for formative assessment purposes was an intriguing development from the partnership. The importance and utility of formative assessment in supporting student learning is well established (Ayala et al., 2008; Furtak, 2009; Heritage, 2007; Herman, 2008; Ruiz-Primo & Furtak, 2006). The prevalence of technologies and devices in classrooms, however, opens the question of how these can be utilized for formative assessment purposes. McGuire (2006) found that when students shared their work in online spaces, they experienced the sense of having an audience, which in turn, made the students more motivated and empowered and yielded higher expectations for providing high-quality work. Flip provides students with this sense of audience and could lead to higher quality responses, which in turn, could allow teachers to use this detailed information to assess students' science conceptual understanding.

Engaging in the coaching conversations allowed Maggie to focus specifically on the use of Flip in her instruction and explore how it could support her students' learning. Her initial adoption of the tool came from a need to support student engagement across the 5E instructional phases and was a direct result of her interactions with her coach, who suggested Flip as a tool that might be interesting to use and engaging for her students. This suggestion was provided as one of several possible options for Maggie to try (google doc, padlet, Flip). There was no expectation that she take up this specific suggestion. It was offered as a possible tool that might support her students, and ultimately, it was Maggie who determined which tool to use.

This decision by Maggie was an instance during the coaching partnership where the partnership principle of *choice* was embodied and realized through the interactions. Because Maggie was required to participate in the coaching partnership as a feature of her teacher education program and had little autonomy as to the content she was teaching due to the district pacing guides, there were limited opportunities for Maggie to exercise choice. However, by offering the tool Flip as one of several possible options, her coach allowed for some choice in the partnership.

Choice is an essential feature of effective coaching partnerships, and learning is most effective when teachers have choice in what they learn and how they learn it (Knight, 2007). While Maggie's choice was limited in the coaching partnership, this moment of choice was important to her success in learning to implement Flip in her teaching.

Throughout the coaching partnership, Maggie and her coach engaged in conversation to make sense of Flip, its utility in elementary science, and how best to utilize it with her third-grade students. These conversations leveraged the partnership principles of *dialogue* and *voice* throughout, allowing Maggie to express her thinking and understandings around the tool, as well as her thoughts of what her students needed to be successful with the tool.

As an example, these principles were demonstrated through the conversation focused on the prompt Maggie provided her students asking, "How do plants use sunlight, air, and water to make food for plants?" The conversation that ensued as Dr. Karl asked for further clarification of the

types of ideas Maggie was hoping her students would provide allowed her to exercise her voice in the partnership. It also opened opportunities for dialogue around the prompt she was providing and the rubric she was using within Flip to assess that learning. This created a space where Maggie could "openly communicate what [she] thought" through "conversation that enabled [her and her coach] to think together" (Knight, 2007, p.53).

The partnership principles of *praxis* and *reflection* also played important roles in the conversations that Maggie and her coach engaged in around Maggie's instruction and allowed for productive examination of Flip in her teaching and elementary classroom. These principles were in many ways designed into the coaching partnership, both from the structure that was established for the conversations by Dr. Karl and as the overall aim for the partnership.

Dr. Karl structured the coaching partnership as an every-other-week meeting to allow time for the preservice teachers to plan, implement, and reflect on the specific instructional practice or strategy they were focusing on during this semester. The conversations themselves were designed such that each conversation began by reflecting on the lesson implemented the previous week before shifting that planning forward on the upcoming lesson and how the learning from the previous implementation could be applied and further refined for continued improvement. These opportunities to reflect in multiple directions are important to supporting teacher learning, because they provide opportunities to look back on how lessons went and apply that learning to future instruction (York-Barr et al., 2016).

This study opened several potential new directions for research around preparing preservice elementary science teachers and around the specific technology tool, Flip. In regard to preparing elementary science teachers, the coaching partnership presented here raised intriguing results and questions for further exploration. A deeper and more detailed look at how coaches and PSTs interact and construct identities, activities, and knowledge within those conversations is warranted. We acknowledge that a complication in this study was the direct involvement of Dr. Karl within the study and the multiple roles he has played within this study, including methods course instructor, science coach, researcher, and author. These multiple roles may have influenced the interpretations, but they have the benefit of providing direct insight into the thought processes and decisions made by the coach in the moment. Future studies exploring coaching conversations with PSTs might seek to explore the coaching performed by individuals not part of the research team.

Flip presents an interesting case for future research. An extremely popular tool amongst K-12 teachers, Flip is widely used within classrooms with students. However, the literature that examines how Flip is utilized by teachers to support student science learning for assessment purposes or that examines the challenges and affordances it brings to the K-12 science classroom is lacking. Future research can examine specific uses of Flip within the science classroom and the role this tool plays in supporting student learning, as well as how student responses provided through the

platform can be utilized to formatively assess student understanding and drive adjustments in instruction.

One framework that may be useful when examining Flip's utility in the science classroom is Kimmon's (2016) PIC-RAT framework. This framework, built on the initial work of Hughes et al. (2006), provides a means to examine Flip and the ways it is utilized in teaching and learning. It explores both student relationships to the technology and teacher implementation of the technology. Students engage with technology in either passive, interactive, or creative (PIC) manners (Kimmons et al., 2020), while teachers implement that technology to either replace, amplify, or transform (RAT) learning activities (Hughes et al., 2006). The aim is that teachers use technology to move toward more creative and transformative learning experiences, as opposed to simply passive replacements of learning tasks (Constantine & Jung, 2019).

Through this theoretical lens, Flip's utility as a technology tool could be examined to determine the passive, interactive, or creative ways in which students can engage with the technology while also exploring how teachers use it to either replace, amplify, or transform the learning activities for students. Applying this framework to Maggie's work demonstrates some of the potential of Flip as a tool for elementary science classrooms. Her students interacted and created through Flip, and her use within her instruction and assessment was at least amplifying and, arguably, transformative. Instead of completing written prompts and exit tickets as they previously had, students were now able to use multiple modalities to share their thinking (speaking, writing, and drawing) and were provided with opportunities to engage in discourse and conversation with a partner around these activities. Further examination of Maggie's implementation, as well as the examination of other teachers' uses of Flip, would be fruitful for understanding how it can innovate learning activities.

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