Using University Science Courses for PST Internship

Conference Paper · January 2024

CITATIONS
0

READS
64

2 authors:

Jerrid W Kruse
Drake University
103 PUBLICATIONS **573** CITATIONS
SEE PROFILE

Sarah Voss
Western Washington University
16 PUBLICATIONS **86** CITATIONS
SEE PROFILE

Using University Science Courses for Preservice Teacher Internship Experiences

Jerrid Kruse and Sarah Voss
jerridkruse@gmail.com
Drake University
Des Moines, IA

Paper presented at the 2024 Association for Science Teacher Education conference

Abstract

The importance and value of high quality opportunities to authentically practice teaching is key for new teacher development. Unfortunately, securing high quality field experiences for preservice teachers is an ongoing problem for many teacher education programs. This article describes how we used our own university-level science content courses to provide preservice teachers with robust teaching experiences through teaching internships. We share our insights from engaging interns for the last 10 years as well as the key elements of the internship experience from the perspective of former interns.

Keywords: preservice teacher education; field experiences; teacher internships

Introduction

Helping preservice science teachers develop and consistently enact reforms-based science teaching remains a challenging task. Beginning teachers often struggle to implement student-centered instruction even when they recognize the importance of doing so (Akin & Uzuntiryaki-Kondakci 2018; Schneider & Plasman, 2011). Because practical learning opportunities can be an important driver for the development of preservice teachers' pedagogical knowledge (Findlay & Bryce, 2012; Karal & Alev, 2016), such opportunities are often included as part of preservice methods courses. Yet, it can be difficult to provide high-quality practicum experiences for a variety of reasons. In this paper, we report on a unique way we provide high-quality internship experiences for our preservice secondary science teachers using our own university-level science content courses.

Practice to Support Teacher Learning

Practical learning opportunities are one of the most significant contributors to the development of preservice teachers' pedagogical knowledge (Findlay & Bryce, 2012; Karal & Alev, 2016) Thus, Ball & Forzani (2009) noted the importance for teacher preparation programs to provide "repeated opportunities for novices to practice carrying out the interactive work of teaching and not just to talk about that work" (p. 503). Such opportunities for practice can occur within a variety of contexts including informal programs (e.g., after school clubs, summer camps, community-based placements), K-12 schools, and higher education (e.g., undergraduate lab courses) (Cohen et al., 2013). Within these various contexts, preservice teachers have the opportunity to reflect on how their experiences relate to learnings from their coursework, thus helping to bridge the gap between theory and practice (Allsop et al., 2006; Fuentes-Abeledo et al., 2020). As preservice teachers engage in reflection on practice, they can experience "internal

changes" (i.e., changes in beliefs and perceptions) and "external changes" (i.e.., changes in pedagogy) that bring them closer to a vision of reform-oriented science teaching (Stroupe, 2022).

While practica provides experiences that might be used to facilitate connections between theory and practice, changes in preservice teachers' beliefs and actions are unlikely to happen without support. In a study of preservice teachers engaged in a practicum, Lotter et al. (2009) found that "Although the practice teaching experiences were vital, the key to changes in the students' teaching skills came through the guided reflections tied to the teaching experiences" (p. 574). More specifically, Lotter et al. noted that a focus on missed opportunities helped preservice teachers frame mistakes or less effective aspects of their teaching as opportunities for growth. Thus, preservice teachers must have structured opportunities within practica to identify "discrepancies between their anticipated and actual experiences, new insights, and suggested possible changes" (Hanuscin & Zangori, 2016, p. 805). When prompted to reflect with a critical mindset, even observations of more teacher-centered instruction can "strengthen resolve" to teach in a student-centered, inquiry-based manner (Varma & Hanuscin, 2008, p. 610). Recently putting various recommendations into practice, Kruse et al (2022) developed a highly supported field experience in which preservice teachers significantly improved their actual teaching practices compared to a more traditional placement. The authors noted key aspects of support to include: modeling of effective science instruction by the cooperating teacher, real-time guidance and feedback from the methods professor who attended practicum alongside the preservice teachers, self-analysis by preservice teachers, working with smaller groups of students, and collaboration among preservice teachers.

Unfortunately, not all field experiences are as highly supported. Often, there is a disconnect between practica and methods courses. One reason for this disconnect is the difficulty in finding practicum placements that model reform-based science teaching (Kruse et al., 2022; Varma & Hanuscin, 2008). Zeichner (2010) noted that for many teacher preparation programs,

> the placement process in college and universities is 'outsourced' to a central administrative placement office rather than being based in departments, and cooperating teacher availability and administrative considerations rather than what is best for the learning of the novice teachers often determines where prospective teachers are placed for their school experiences (p. 90).

The result is that many preservice teachers end up in classrooms with mentor teachers who teach science traditionally. When a mentor teacher utilizes teacher-centered instructional routines, preservice teachers not only miss the modeling of and support for reform-oriented science teaching, but also have limited access to student thinking (Braaten, 2019), an important resource for developing knowledge of effective science teaching (Magnussen et al., 1999; Carlson & Daehler, 2019). Preservice teachers who end up in such placements often have difficulty advocating for experiences that better match what they are learning in methods courses (Allsop et al., 2006). Further, practica are often supervised by clinical faculty and graduate students (Ziechner, 2010). Thus, methods instructors may be limited in their ability to help preservice teachers connect practicum experiences to learnings from methods courses and provide timely feedback on teaching experiences because the instructors do not observe what is going on firsthand (Allsop et al., 2006). Because we recognize these challenges for creating successful

field experiences, we sought a new way to provide additional practical experiences to preservice teachers at our institution.

Internships in University Science Content Classes

Program Context

Our university is a medium-sized institution. Because of our smaller size and a liberal arts focus, science education faculty have the opportunity to teach science content courses. For example, the authors have taught courses for the university's chemistry department, physics department, computer science program, and interdisciplinary science content courses that meet the general education requirements for science. These science content courses, taught by a science teacher educator became the focus for our new internship experiences.

The internship experiences described in the next section were in addition to the traditional program requirements. All preservice teachers take six pre-professional courses including: Foundations in Education, Educational Psychology, Educational Technology, Planning and Assessment, Introduction to Special Education, and Perspectives on Race, Gender, and Ethnicity. After these courses, preservice secondary science teachers take General Secondary Methods and Disciplinary Literacy as well as three science education courses: Secondary Science Methods, Nature of Science, and Methods of Engineering and Technological Design. During the program, preservice teachers complete at least 100 hours of practicum experience in local K-12 schools before student teaching

General Description of University Science Course Internship Experiences

Multiple discipline-specific methods courses and scaffolded practical experiences with students are hallmarks of effective preservice teacher education (Bergman, 2007; Chval, 2004; Herman, Clough, & Olson, 2013; Hanuscin & Zangori, 2016; Krajcik & Penick, 1989; Kruse et al., 2017; Kruse et al., 2022; Olson, 2017; Roehrig & Luft, 2006; Tillotson & Young, 2013). Yet, not all experiences are equal and many K-12 field experiences contradict the ideas and reforms-based teaching promoted in our methods courses. Our own research found that highly supported field experiences help preservice elementary teachers engage in much higher levels of reforms-based teaching than more traditional field experiences (Kruse et al., 2022) with modeling and feedback serving as crucial elements for providing support to preservice teachers. Thus, we sought ways to provide such support to our preservice secondary science teachers (PSST) by leveraging our own science content teaching at the university level. Having our PSST serve as interns in our science content courses provides them with experiences and practice implementing instruction with our support and guidance. Of course, engaging PSST as interns in content-based courses is clearly context dependent. If science teacher educators find themselves teaching large lecture sections of science content courses, inclusion of PSST interns will look different than in a small laboratory course. Below we briefly describe various ways we have integrated PSST interns into courses at our university.

Interns as Teaching Assistants. Most PSST start as teaching assistants in one of our courses. As a teaching assistant, the PSST most often helps facilitate small group activities. These small group interactions provide low-stakes opportunities for PSSTs to practice the skills they have learned in methods courses. Toward the end of the semester, PSSTs may begin to lead short whole-class discussions making sense of observations or engaging the students in nature of science discussions. While we discuss upcoming lessons and activities with the PSSTs in this phase, they are less involved with planning lessons.

Interns as Co-teachers. If PSSTs are ready and have time before they are scheduled to student teach and graduate, we encourage them to complete a second internship experience with us. These second internships may occur in the same course they previously served as a teaching assistant or a different science content course. Often, these experiences happen during our university's January term in which students enroll in only one course for three weeks. Many of our PSSTs complete this second internship during the January before they student teach.

During this "co-teaching" internship, PSSTs are given more responsibility and usually plan lessons and units with feedback from us. For example, during one January course, a PSST was responsible for the unit on matter. While they had previous course materials to refer to, they created their own plans, shared them with the teacher educator for feedback, and enacted all classroom teaching with the science teacher educator serving in more of an assistant role. Of course, the teacher educator was there to take over or point the class in a new direction if necessary.

Interns as Exemplary Instruction. Some of our PSSTs become so adept at engaging in inquiry-based instruction, that they can serve as models of effective instruction. Thus, we invite some PSSTs into our secondary or elementary methods courses to serve as interns. During this internship, we leverage the PSSTs skills by asking them to enact example lessons. This enactment allows us (the science teacher educators) to draw the methods students' attention to various characteristics of the lesson or the teaching and encourages the methods students notice slight variations in the teaching approach to reflect on how those variations might align to their own personalities and goals. While not all PSSTs engage in this level of internship, we have found that those that do are a tremendous resource for improving our methods courses.

Specific Features, Strategies, and Considerations for Successful Internship Experiences

This section highlights more nuanced aspects for successfully engaging preservice teachers as teaching interns within university science courses. The features and strategies highlighted here are the result of both instructor reflection and analysis of data collected from preservice teachers who have participated as interns. Although this is not a research study, we attempted to collect a wide-range of participant views and develop themes in a systematic way.

Participant views of the internship experiences were elicited through a combination of semi-structured interviews, written reflections, and informal conversations. Seventeen (17) preservice teachers who have participated as interns over the last 10 years were contacted to reflect on their experience as interns within a university science course. Eleven (11) responded with five of the most recent interns keeping a reflective journal throughout the experience and participating in a post-internship interview to explore their perceptions of the experience in more depth.

Both authors reviewed data separately and developed emergent themes from the data. The two authors' themes were compared and refined using quotes from participants. The themes generated from analysis of participants' words are presented below alongside recommendations and reflections from the perspective of the first author who supervised all of the 17 preservice teachers in their university science content internships.

High Support. Providing high support is the first main theme for effective implementation of a university science content course internship. All former interns identified the highly supported nature of the internship experience as a significant affordance. For example, one intern wrote, "I found the TA experience valuable because it provided opportunities to practice the development of lesson plans and try out actual teaching practices in a supported

setting." Another teacher described the internship as "much more process-based" in contrast to other practical experiences wherein teachers were either limited to observing a final product or implementing a single phase of teaching (i.e., lesson planning, implementation, reflection). Because we (the teacher educators) were planning, implementing, and reflecting upon instruction alongside the preservice teachers, the instruction was highly aligned to the methods courses the preservice teachers completed and many opportunities existed for scaffolding, feedback, and collaboration. Each of these specific elements of support are further discussed below.

Consistency with Methods Courses. Perhaps the main reason the first author initially created the university content course internship was to help preservice teachers observe and practice research-based instruction they were learning in methods courses with real students. This alignment between the methods courses and the internship served to support preservice teachers in implementing research-based teaching rather than having to work against traditional instructional approaches and routines that often exist in traditional practicum placements. Current and former interns described this contrast between their experiences with the university science content internship and the challenges they experienced in other practicum placements with more traditional teachers. For instance, one intern described the difficulty of facilitating a student-centered discussion with a group of students who were used to being asked recall questions and then provided with evaluative responses: "you have silence because some of those students or those teachers might not have that methodology that we've been learning." In contrast, that same teacher noted that in the university science content internship "we were actually like, doing the way that we actually are getting taught to teach science." Another participant wrote:

> Occasionally in student teaching, a mentor teacher does not use the same methods that a preservice teacher had learned about and therefore the preservice teacher has a more difficult time implementing and receiving feedback on these new methods. Serving as [an intern] with my methods teacher, eliminated this possible concern.

Thus, preservice teachers recognized the value and important way alignment between their practice experiences and their university methods courses can support (or not support when unaligned) their development as teachers.

Because the interns seemed to view the university science content internship as an extension of their science methods course, they viewed their learning as "practice" more so than new knowledge. As one teacher said, "I didn't learn a whole ton of new stuff, but it's just the getting better at the stuff that I know." Another teacher exclaimed the wide applicability of the experience noting,

> I feel like all the major things that I learned are things that apply to just about any aspect of your teaching. Because it's asking better questions, having quality pacing, dealing with student misconceptions or unanticipated student responses…those are things that are going to pop up in just about any area of science teaching.

The teachers recognized that the university science content internship functioned to help them solidify the broad, but vitally important, knowledge and skills they had begun to develop in science methods courses.

Scaffolding. As with all learning, careful scaffolding is key to encourage learners to continue making progress without feeling overly frustrated. In general, we attempt to scaffold by increasing the responsibility of the interns over the semester. For example, early in the semester, the interns might only help facilitate small group discussions. Then after a few weeks, interns may complete a short demonstration activity and engage the class in a short five-minute discussion. As the semester progresses, the interns often engage the class in developing an investigation and/or making sense of data collected during an investigation. Although interns do tend to spend quite a bit of time observing, this is not the main goal for the interns. As one intern noted, "I don't think [observing] was nearly as beneficial as [when] I got to teach and receive feedback". Thus, getting interns involved in some instructional capacity early in the semester and scaffolding toward increased responsibility is recommended.

Most often we host one to three preservice teachers as interns in a university science content course. This small number of interns allowed for highly individualized scaffolding. Some interns may take more responsibility earlier in the semester or have more opportunities to work with the whole-class of students. Such individualized scaffolding depends on the interns' familiarity with the content of the course, their progress through their teacher education program, or simply their demonstrated instructional prowess. Because we are responsible for maintaining the quality and rigor of the university science course, we have to carefully balance our goals for the university science content students with our goals for the interns.

Much of the individualized scaffolding occurs during planning and reflective discussions between the teacher educator and the interns. For example, sometimes interns are tasked with developing an initial plan for a particular aspect of the course content. Then, we discuss the proposed plan and how to modify it for implementation. In addition, after the intern implements instruction, we again discuss what went well and what can be improved. During these discussions, we prompt the intern(s) to notice particular nuances of instruction such as the phrasing of questions or possible classroom management concerns.

Some scaffolding also occurs in the moment of teaching. Because the interns are teaching in our science content course, we are always present and involved in instruction in some capacity. Thus, when the interns are teaching, we may interject their own questions to help move the conversation forward. One particularly useful strategy is to have the class discuss something in their small groups while we discuss with the intern a possible way forward in response to the emerging conditions of the classroom.

While learners often do not recognize the way scaffolds are supporting their learning, the interns did seem to recognize the value of various scaffolds. As one former intern described, "he'd go over [lesson plans] with us. That way, we knew if the flow was right, or what questions we're asking. So it was good that we could tweak it." One intern wrote that the most valuable part of the internship was "planning a lesson with colleagues with master teacher input". Another commented on the importance of the internship at the right time in their program noting "I think if I had done the [internship] experience earlier in my undergraduate time…it would have been a lot more intimidating and potentially not as helpful of an experience."

Feedback. Timely feedback is a hallmark of effective learning environments. During the university science content internships, preservice teachers receive mostly informal feedback in the form of direct conversations with the teacher educator. Usefully, these conversations often happen just after a teaching episode or even during a teaching episode. For example, sometimes an intern may remain positioned in one place at the front of the classroom. When this happens, the teacher educator may simply point in a direction to encourage the intern to move around to

better manage and engage the class. Other times, the intern may ask a confusing question. When that happens, we sometimes have the class discuss the question in their small groups and confer with the intern as to how they can rephrase the question more productively. As the intern progresses, the feedback sometimes becomes more formal. That is, as the intern is teaching, we type up notes about the teaching episode and send them to the intern via email for reflection after the lesson is over. As a final stage of assessment, we ask the interns to video-record their teaching, watch it, and then send us their self-assessment before we discuss the teaching episode together. Our goal is to help the interns move from relying on teacher educators for feedback and improvement and instead develop their own critical eye to continue to improve their practice well beyond their time with us.

While some teachers expressed that they were nervous to be directly supervised by the teacher educator, they greatly valued the feedback as a means of improving their practice. For example, one former intern said, "Teaching as a preservice teaching while being observed and receiving immediate feedback from your methods professor can be intimidating", but went on to say,

> It was valuable to be in the teacher role while being observed by my methods professor. This allowed for many sidebar conversations during my lessons, on quick ways to improve or move the class in the direction I was wanting. It encouraged constant reflection of my own actions and methods during class, and gave me time to fix and improve upon them immediately.

Another intern noted the value of the feedback as they prepared for student teaching:

> The feedback I received from my professor about my teaching/planning was valuable because I learned about my strengths and weaknesses as a teacher before student teaching. I knew what I needed to work on and continue to do so I feel like I was more prepared going into student teaching than I would've been if I had not had teaching experience as a TA.

Recognizing the value of feedback during the planning phase of instruction, another intern wrote, "Being able to plan your own lesson and get feedback on what might work better was invaluable." Articulating the all encompassing nature of the way feedback served to support the interns, yet another intern noted:

> I think the most valuable part of the TA experience was the immediate feedback/debrief I was able to receive after just about every time I taught. I was able to get feedback on lesson plans that I developed and was able to develop those lessons with the help of someone with more experience; I was able to get feedback on my questions and scaffolding during my teaching.

The importance and value of feedback was perhaps the most common theme from the former interns' reflections. As noted previously, many interns found teaching in the presence of their professor intimidating, but all found the feedback to be key for their improvement as teachers. One teacher commented, "I want to do it, I want to hear the feedback. …So I want to apply it so that I can better and improve myself." The immediate nature of the feedback seemed

to be especially appreciated. One teacher described the feedback process: "[the teacher educator] was watching and giving us feedback right after whether it's via email, or just physically say, a couple of, you know, strengths or weaknesses that we could improve upon."

Collaboration. As established by previous intern comments, the collaboration with and feedback from the teacher educator is a valuable component of the internship. Yet, several interns also noted the ways their fellow interns served as support during the internship. As one intern explained:

> I was fortunate to [intern] with another person so I was able to bounce ideas off of them and also learn from watching them [teach]. I got to see strategies that worked and what didn't work. I would recommend having at least 2 [interns] at a time for those benefits.

Echoing this sentiment, another intern noted, "It was also very helpful to have another [intern] partner to collaborate and bounce ideas off of each other." This collaboration among preservice teachers may set them up for the peer support networks so valuable for long-term implementation of effective teaching (Herman et al., 2019).

Authentic. The authentic nature of the internship is the second main theme illustrating the value of university science content internships for the development of preservice teachers. While teaching at the university-level is not exactly the same as teaching in a K-12 setting, the science content courses we teach are specifically designed to be taken by non-science majors. Thus, although the students in the classes are older and perhaps more ready or willing to take on rigorous coursework, they are not particularly interested in science or pursuing a science career. In this sense, and in our experience, the university science content courses we teach are rather similar to teaching high school science.

The interns reaffirmed the authentic nature of the experience. Reflecting on their experience, one former intern claimed the internship "provided the perfect authentic teaching scenario prior to student teaching". Another intern exclaimed,

> I strongly believe anytime a preservice teacher is getting real experience teaching and planning AND being observed by their methods professor is an incredibly powerful experience. As these experiences happened more frequently, I became not only a more skilled but more confident teacher. I believe entering the career with confidence in my abilities has allowed me to still be teaching 5 years later."

Of course, teaching at the college level posed challenges for the interns. For example, one intern felt intimidated by teaching students her same age:

> One thing I found challenging about the experience was that I was an undergraduate student, and was a TA for a course that consisted of other undergraduate and some graduate level students. While I felt more comfortable with the content and methods than the students in the course, it was challenging to not be intimidated by "teaching" my peers.

Other interns viewed the older students as "less intimidating and less judgmental than teenagers", providing a useful scaffold for improving their practice. One claimed that because "the students

in that class were my age/older, it was a bit daunting at first, but gave me an extra push to practice my teaching skills."

Although teaching fellow preservice teacher peers has generated concerns about the authenticity of the experience (Stroupe & Gotwals, 2018), our interns did not seem to have those concerns with teaching non-education university students in a science course. One intern, who is now a high school chemistry teacher, even claimed the university science content internship "felt more realistic to the teaching I do now than what I did in many practicums." Summarizing their perspectives on the authentic nature of the internship experience one participant wrote:

> I found the [internship] experience valuable because it gave me extra practice/support with planning effective lessons. Before student teaching, I did not have as many opportunities to develop lessons and activities before teaching them (many were guided or provided by the practicum teacher). With [the internship], I was able to focus on inquiry-style teaching and how to plan for those types of lessons. Furthermore, it helped me learn to think quickly and work with my "students." Since I was [intern]ing with college students, it was a different experience compared to teaching 6th graders; I had to learn to adapt to their responses and background knowledge which I found a very helpful skill. Ultimately, it was just a really great source of extra teaching experience!

Such authentic experiences provide ample opportunity for the preservice teacher interns to work on an area of challenge, navigate the unexpected, and increase their confidence. Each of these features/subthemes are discussed further below.

Working on an Area of Challenge. The authentic nature of the internship created opportunities for the preservice teachers to target specific aspects of their teaching to improve upon. While teachers recognized that the university content course internship was a good way to improve their science teaching generally, they tended to focus their reflections on a particular skill they improved throughout the experience. For instance, one teacher came to realize that her classroom presence had a large impact on student engagement and worked to demonstrate greater enthusiasm in her teaching. She said, "I have to remind myself, you know, put on my theater face and perk up." Another teacher worked to find a format for lesson plans that would allow them to write plans quickly, but with enough detail to enact effectively. A third intern remembered specifically "discussing how to grade the assessments, and I remember that being foundational to developing my thought process of how to grade."

Several students focused on facilitating more effective student-centered discussions, but in different ways. For instance, one teacher focused on their ability to utilize appropriate wait time and student ideas in discussion: " I wanted to work on the wait time and using their ideas to deepen the discussion and get them thinking … like providing reasoning for their thinking. That was my biggest thing." Another teacher identified pacing as an area in need of improvement. He noted a need to work on "how I go about asking questions and then moving on to different questions or other topics or the things I want students to focus on the wait time I give…, so it's an appropriate…it's long enough, but also not too long." Regardless of the area of challenge they chose to work on, the blended teaching experience provided teachers with an authentic space to repeatedly practice in a supportive environment.

Navigating the Unexpected. Because the teaching was in a real classroom with real science learners, things did not always go as predicted – creating authentic opportunities for the interns to navigate the unexpected. Through their experience in the university science course

internship, interns claimed to gain an appreciation for the emergent nature of student-centered teaching. The teachers recalled multiple times where questions they asked did not elicit the responses they expected or desired. One teacher recalled,

> they were not coming to the answer… for it was probably like two to three minutes. And then you can't just be like, 'hold on a second' and then think. Like, I had to actively think of a different way to ask it while I'm still in front of them.

Another teacher identified the greatest challenge of the experience as "addressing things that come up in class that I just didn't anticipate." They elaborated, "student responses that would come up and I'd be like, 'well, I had not expected things to go this way."

While unexpected responses from students could be frustrating for the interns, they noted that the teacher educator helped them understand that such unexpected events were just part of teaching. One teacher described asking the teacher educator what she could have done to prevent an awkward silence from happening. She said the teacher educator replied by laughing and saying, "It's gonna happen, but you don't know until you experience it" and reassuring her that she handled it as best she could by asking additional questions that helped steer students in the desired direction. With the support from the teacher educators, the inters came to see the internship as an opportunity to practice what one student referred to as the "improvising piece of teaching."

Increased Confidence. As with learning any new set of skills, opportunities for repeated practice are required to improve confidence with new ideas and strategies. The interns recognized the importance of multiple opportunities to go through the cycle of planning, teaching, and reflection for improving their teaching. One teacher said, "it was much more beneficial I thought, at least for me, to practice those skills and then receive that feedback, apply, and then do it over again". These repeated practice opportunities clearly increased the interns' confidence to engage students in inquiry. One intern noted, "the extra practice teaching prepared me to be more comfortable and confident while in front of students." More specifically, one intern claimed, "[the internship] built my confidence a lot more to be able to run those kinds of discussions," while another teacher said that her participation boosted her confidence to be able to develop and deliver activities like the ones she experienced during the internship. This increased confidence, in turn, seemed to help cement the teachers' commitment to inquiry-based, student-centered teaching. One teacher explained, "there's gonna be those days that like it clicks and you can see the reasoning on why it works and why you need to keep doing it." Summarizing the ways the internship supported their development of skills and confidence, one former intern wrote:

> This role increased my confidence as a teacher. Not only had I taught my peers for a semester, but I also received feedback and was able to make immediate changes to start building the habits of a successful teacher. Entering student teaching after this experience, I felt confident that I had many of the skills needed and would continue to fine tune them in the coming weeks.

While the connection between confidence or self-efficacy and effective teaching is still unclear, the confidence built during the university science content internship sets the preservice teachers up to recognize the value of inquiry-based teaching and their ability to engage students in such

teaching. This confidence may provide the needed courage to challenge the more traditional approaches many are likely to encounter in their student teaching or in their careers.

Concluding Thoughts

In general, engaging preservice teachers as interns within university-level science content courses has proven to be a promising approach to support their implementation of inquiry-based teaching. Our anecdotal observations over the last 10 years make clear that preservice teachers make tremendous progress in their teaching prowess during these internships. Indeed, the former interns who provided reflections on their experiences make clear they saw value in these experiences as well. Yet, considering the long-term success of these experiences raises two issues for further consideration.

First, the value of these internship experiences depends on the quality of science instruction happening in the university science content courses. If the instructor of the science content course is engaging in more traditional instruction, the internship experiences are unlikely to be as valuable as when the instructor is engaging learners via inquiry-based approaches. Thus, we as teacher educators have to critically evaluate our own teaching of science content and ensure our teaching aligns with the ideals and principles we profess in our methods courses. We might ask ourselves, "To what extent are we teaching the way we were taught versus the way we hope our preservice teachers will teach?"

Beyond accurately modeling effective instruction, we must also consider how we will support our preservice teachers when they leave us. Too often we hear of preservice teachers who are well prepared to enact inquiry-based instruction that are told to "fall in line" or "follow the curriculum", despite the curriculum focusing on rote memorization and cookbook experiences. One way we have worked to prepare our preservice teachers for the realities of the K-12 profession is to have explicit conversations about how to navigate the hurdles they may encounter. For example, while reflecting during the internship experience we might ask, "The university expects students in our science courses to understand 'the scientific method', how did our discussion today critiquing a single scientific method both meet the university expectation and help students develop a deeper understanding?" In addition, we might call interns' attention to the hurdles they might face in the K-12 world by asking, "At the K-12 level you might not have as much freedom as we do at the university, how do you think you can work within the constraints of that system while also doing what you know is best for your students?" The resulting discussions often note the value of inviting administrators in to observe particular lessons, collaborating with colleagues to revamp lessons to be more in-line with current reform documents, and using professional resources (e.g., NSTA journals, research articles) to inform planning and collaborative discussions.

In conclusion, the use of university science content internships has solved two problems for our science teacher education program. First, some of our preservice teachers were skeptical that high-level science content could be taught using inquiry. When observing college-level students wrestle with fundamental science ideas via inquiry, such concerns are diminished. Second, the internships were initially developed because the preservice teachers in our program reported not observing inquiry-based teaching in their K-12 field experiences. Importantly, our preservice teacher interns still spend over 100 hours in K-12 schools prior to student teaching, and we seek to place them in exemplary classrooms. However, the internships give us certainty that our preservice teachers see and practice inquiry-based teaching in an authentic setting with

as much support as we can give them. With these efforts, we hope to help the preservice teachers become the teachers we know children deserve.

References

Akın, F. N., & Uzuntiryaki-Kondakci, E. (2018). The nature of the interplay among components of pedagogical content knowledge in reaction rate and chemical equilibrium topics of novice and experienced chemistry teachers. *Chemistry Education Research and Practice*, *19*(1), 80-105. DOI: 10.1039/C7RP00165G

Allsopp, D. H., DeMarie, D., Alvarez-McHatton, P., & Doone, E. (2006). Bridging the gap between theory and practice: Connecting courses with field experiences. *Teacher Education Quarterly*, *33*(1), 19-35.

Bergman, D. J. (2007). *The effects of two secondary science teacher education program structures on teachers' habits of mind and action* (Unpublished doctoral dissertation). Iowa State University, Ames, IA.

Braaten, M. (2019). Persistence of the two‐worlds pitfall: Learning to teach within and across settings. *Science Education*, *103*(1), 61-91. https://doi.org/10.1002/sce.21460

Chval, K. B. (2004). Making the complexities of teaching visible for prospective teachers. *Teaching Children Mathematics*, 11(2), 91–97.

Cohen, E., Hoz, R., & Kaplan, H. (2013). The practicum in preservice teacher education: A review of empirical studies. *Teaching Education*, *24*(4), 345-380.

Carlson, J., & Daehler, K. R. (2019). The refined consensus model of pedagogical content knowledge in science education. In A. Hume, R. Cooper, & A. Borowski (Eds.), Repositioning pedagogical content knowledge in teachers' knowledge for teaching science (pp. 77-92). Springer.

Findlay, M., & Bryce, T. G. (2012). From teaching physics to teaching children: Beginning teachers learning from pupils. *International Journal of Science Education*, *34*(17), 2727-2750. https://doi.org/10.1080/09500693.2012.728012

Fuentes-Abeledo, E. J., González-Sanmamed, M., Muñoz-Carril, P. C., & Veiga-Rio, E. J. (2020). Teacher training and learning to teach: an analysis of tasks in the practicum. *European Journal of Teacher Education*, *43*(3), 333-351.

Hanuscin, D. L., & Zangori, L. (2016). Developing practical knowledge of the Next Generation Science Standards in elementary science teacher education. *Journal of Science Teacher Education*, *27*(8), 799-818. https://doi.org/10.1007/s10972-016-9489-9

Herman, B. C., Clough, M. P., & Olson, J. K. (2013). Teachers' NOS implementation practices two to five years after having completed an intensive science education program. *Science Education*, 97(2), 271–309.

Herman, B. C., Olson, J. K., & Clough, M. P. (2019). The role of informal support networks in teaching the nature of science. *Research in Science Education*, *49*, 191-218.

Janssen, F., Westbroek, H., & Doyle, W. (2014). The practical turn in teacher education: Designing a preparation sequence for core practice frames. *Journal of teacher education*, *65*(3), 195-206. DOI: 10.1177/0022487113518584

Karal, I. S., & Alev, N. (2016). Development of pre-service physics teachers' pedagogical content knowledge (PCK) throughout their initial training. *Teacher development*, *20*(2), 162-180. http://dx.doi.org/10.1080/13664530.2015.1124138

Krajick, J., & Penick, J. (1989). Evaluation of a model science teacher education program. *Journal of Research in Science Teaching*, 26, 795–810.

Kruse, J. W., Easter, J. M., Edgerly, H. S., Seebach, C., & Patel, N. (2017). The impact of a course on nature of science pedagogical views and rationales. *Science & Education*, *26*(6), 613-636.

Kruse, J., Wilcox, J., Patel, N., Borzo, S., Seebach, C., & Henning, J. (2022). The Power of Practicum Support: A Quasi-experimental Investigation of Elementary Preservice Teachers' Science Instruction in A Highly Supported Field Experience. *Journal of Science Teacher Education*, *33*(4), 392-412. https://doi.org/10.1080/1046560X.2021.1949099

Lotter, C., Singer, J., & Godley, J. (2009). The influence of repeated teaching and reflection on preservice teachers' views of inquiry and nature of science. *Journal of science teacher education*, *20*, 553-582. DOI 10.1007/s10972-009-9144-9

Magnusson, S., Krajcik, J., & Borko, H. (1999). Nature, sources, and development of pedagogical content knowledge for science teaching. In J. Gess-Newsome & N. G. Lederman (Eds.), *Examining pedagogical content knowledge: The construct and its implications for science education* (pp. 95–132). Dordrecht.

Olson, J. K. (2017). Teacher preparation for science education. In *Science Education* (pp. 523-537). Brill Sense.

Roehrig, G. H., & Luft, J. A. (2006). Does one size fit all?: The induction experience of beginning science teachers from different teacher preparation programs. *Journal of Research in Science Teaching*, 43(9), 963–985.

Schneider, R. M., & Plasman, K. (2011). Science teacher learning progressions: A review of science teachers' pedagogical content knowledge development. *Review of Educational Research*, *81*(4), 530-565. https://doi.org/10.3102/0034654311423382

Stroupe, D. (2022). Understanding the Role of Field Experiences in Preservice Science Teacher Preparation. In *Handbook of Research on Science Teacher Education* (pp. 119-131). Routledge.

Stroupe, D., & Gotwals, A. W. (2018). "It's 1000 degrees in here when I teach": Providing preservice teachers with an extended opportunity to approximate ambitious instruction. *Journal of Teacher Education*, *69*(3), 294-306. DOI: 10.1177/0022487117709742

Tillotson, J. W., & Young, M. J. (2013). The IMPPACT project: A model for studying how preservice program experiences influences science teachers' beliefs and practices. *International Journal of Education in Mathematics, Science and Technology*, 1(3), 148–161.

Varma, T., & Hanuscin, D. L. (2008). Pre-service elementary teachers' field experiences in classrooms led by science specialists. *Journal of Science Teacher Education*, *19*, 593-614. DOI 10.1007/s10972-008-9110-y

Zeichner, K. (2010). Rethinking the connections between campus courses and field experiences in college-and university-based teacher education. *Journal of teacher education*, *61*(1-2), 89-99.