

The Influence of an Alternative Laboratory Placement: Overcoming the Fear of Teaching Science

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As preservice science and social studies faculty worked with a group of underserved and underrepresented students in a rural community in a southern state, this study looked at how to best prepare preservice teachers to teach science autonomously. More specifically, this study looked to address the expressed concerns of preservice elementary school teachers that they have as it relates to their comfort and understanding of how to teach science, particularly STEM-related labs, and activities, along with the day-to-day operations of classroom management and logistics. During this time and study, the preservice teachers were able to build their confidence and needed skill sets because they had total autonomy and control of their preparation, planning, execution, classroom management, classroom support services, and before and after class activities. The certified mentor teachers were present due to state requirements as well as being able to offer context, support, and reference to specific students and community perspectives. During this study, the author regularly observed and monitored the preservice teachers as they developed individually from expressing fears of not only teaching science for the first time, but also sharing their concerns for classroom management, and time management, as well as developing interpersonal relationships with new students. For some, they were able to learn not all experiences will be positive, there will be challenges and limitations, however, there is great satisfaction to be gained as they recognized that experience is the best teacher.

Keywords: autonomy, classroom management, preservice teacher, mentor teacher, alternative lab, teacher educators, field experience

Introduction

Concerns about the quality of the nation's public education system have increased attention to the key element of teacher effectiveness within recent years (National Commission on Teaching and America's Future, 1996). There is little consensus on what constitutes high-quality teachers. Past research has emphasized two broad dimensions of teacher effectiveness: (1) the level of knowledge and skills that teachers bring to the classroom, as measured by teacher preparation and qualifications, and (2) classroom practices. In 1998, The National Center for Educational Statistics (NCES) conducted a survey to provide a national profile on the first dimension of teacher quality—teacher preparation and qualifications.

Data showed that the teachers surveyed felt more prepared to handle classroom management (71%) and less than prepared to adequately address current state and local curricula (44%) and new teaching methods (45%). Therefore, the general problem is that teacher preparedness in the classroom and an advanced level of knowledge and skills needs improvement (Arends & Winitzky, 1996).

College and university education departments across the country have sought to find innovative ways to prepare preservice teachers to teach science. In many methods classes of colleges of education across the country, the use of portfolios, professional development schools, case studies, co-teaching experiences, mentoring, field-based assignments, role-playing, and many other practices have been used by professors for the preparation of preservice teachers. Even though these preservice teachers are given all the means of preparation, they are still somewhat concerned about whether they are prepared enough to teach and feel confident enough to be in the classroom. Research has shown that there is much stress and apprehension at the thought of teaching science. The challenge for educators responsible for methods courses is to help preservice elementary teachers develop the attitude, self-efficacy, and teaching skills that will allow them to teach (Howitt, 2006).

The Carnegie Task Force (1986) agrees that field experiences should be an integral part of teacher education programs. Field experiences are critical links between formal teachers' training and are viewed as positive in the development of teaching behaviors. Most of the time new and veteran teachers are asked what was the most valuable or significant part of their preparation for teaching. They often respond that practical experiences from their field experiences were a key component in preparing them for teaching. Field experiences, labs, and practicum have always been vital in teacher education programs. Field experiences have emerged as a critical dimension of the teacher preparation process. In recent years much has been written regarding the efficacy and effects of field experience involvement for preservice teachers (Watson, Miller, & Patty, 2011). Field experiences also represent the closest juncture between formal teacher training in universities and on-the-job training in schools (Dodds, 1988). Field experiences introduce the student to the "real world" of teaching by having preservice teachers practice their skills with real students, and teach lessons under monitored supervision, and in most cases, the supervision of the preservice teacher is that of the cooperating teacher. Teacher educators continue to address the concerns of preparing elementary preservice teachers to teach and increase the amount of time students spend in the field (Cole & Knowles, 2000).

This paper will look at the response to national and local needs of teacher preparation programs in a summer science camp for girls' project conducted at a southern university in the United States. The summer science camp project sought to improve preservice teachers' attitudes toward teaching science to diverse learners. Out of this study came surprising information about preservice teachers' thoughts and ideas about working in the science camp as an alternate field lab placement for their science and social studies methods courses. This idea of an alternative lab was of interest to two professors at the university, especially since most of the lab experiences had by preservice teachers this southern university was involved in were the traditional lab field experience. This paper seeks to describe an alternative field placement for preservice teachers that are inclusive of all teaching responsibilities that usually are not found in the traditional lab experience.

Typical University Teacher Education Program

Field experiences at this southern university are an integral part of the coursework for three semesters prior to student teaching depending upon their preservice teacher's cohort sequence. Field experiences for students are all in multicultural settings where there are students whose ages levels and ability levels vary. Preservice teachers are placed in schools where they can observe and work in small groups allowing them a chance to utilize the philosophy and methods presented in their method's course. In the field experience model at the university preservice teachers' responsibilities start with students working in small groups and moving into large groups. The total number of field experience hours for one course is 45 contact hours. Methods instructors choose

elementary or middle schools in the surrounding area. The cooperating teachers assigned to the preservice teachers must have at least three years of teaching experience and express a concern to host a preservice teacher in his/her classroom for a semester. Once cooperating teachers have been chosen by the principals of the schools, methods instructors meet with teachers to provide an overview of the field experience. During this time the expectations of the preservice teacher, cooperating teacher, and university instructors are explained and cooperating teachers have a chance to discuss their concerns ranging from absences, instruction, tardiness, dress, and professionalism. Cooperating teachers complete required lab attendance forms at the end of each week and submit a midterm and a final evaluation form.

The Science Camp Study

This science camp study originally focused on preservice teachers' attitudes toward teaching science and their attitudes towards teaching diverse learners in a summer science camp as part of the requirement for their lab placement in their social studies methods course. The students enrolled in either social studies methods or science methods used the science curriculum and integrated social studies and vice versa. This integrated lab field experience will be called alternative lab placement (ALP) because it was unique and different in its format and model from that of the traditional model. The ALP is defined as a nontraditional field placement of teaching allowing preservice teachers to experience a hands-on experience that parallels the job training with supervision of mentor teachers from the local schools of the participating girls in the camp, university professors from the southern university, and peer on peer supervision of the preservice teachers. Typically, most on-the-job training provides feedback from one main supervisor but in this case, the preservice teachers received feedback from several sources. Paese (1989) noted seven advantages of including field experiences in professional teacher training:

- (a) preservice teachers can make better career choices
- (b) field experiences can bridge the gap between theory and practice
- (c) courses within the curriculum are more meaningful
- (d) preservice teachers gain a better understanding of children
- (e) preservice teachers gain a better understanding of responsibilities as teachers
- (f) preservice teachers gain a better understanding of their ability to teach children and have the opportunity to develop teaching skills
- (g) preservice teachers realize that there is more to teaching than telling children what to do

The ALP not only provided experiences for preparation for teaching but an opportunity for preservice teachers to focus on their career choice in teaching by experiencing the responsibility of having their classroom, the responsibility of control of the girls, the responsibility of daily routines, such as restroom duty, lunchroom duty, and bus duty; which is normal for that of the regular classroom teacher.

The ALP Framing Details

During the summer for the most part field placements are somewhat difficult to secure because schools are typically out for the summer and summer school only provides a minimal to no degree of classroom instruction in science or social studies. Traditionally field experiences are held off campus, which involves working in the school environment with a group of students (Dodds, 1988). Class placements of preservice teachers are often made out of convenience and because of teacher goodwill (Ross, Hughes, & Hill, 1981). In the ALP 10 preservice

teachers were recruited based on the following: completed science, math, and methods courses, enrolled in the social studies/language methods, and expressed a strong interest in participating in the camp. One reason for choosing the following criteria was: the summer science camp was interdisciplinary with a focus on integrating science with dance, music, art, drama, language arts, social studies, math, and technology. There were two methods professors (science and social studies) interested in giving the preservice teachers a lab experience that would encourage them to use scientific inquiry, become problem solvers, develop interrelationships across disciplines, and develop student-centered classrooms instead of focusing on teacher-directed classrooms. The camp provided the preservice teachers with an alternate field base placement that went beyond the traditional lab experience which created a unique simulated classroom.

The ALP included mentor teachers in the classroom to provide advice and support to preservice teachers. These mentor teachers observed the preservice teachers' progress, answered questions related to classroom management, and provided feedback verbally and written and unstructured and structured conversations with the professor. The preservice teachers were given full responsibility of their class from morning to afternoon. In comparison to a previous summer camp the field experience was somewhat similar to a traditional field experience in that preservice teachers were off campus and had a small group of students and the mentor teacher in the classroom provided instruction as that of the cooperating teacher. For this summer camp, ALP was structured so that the preservice teacher would have complete control of the students and the mentor teacher would assist the preservice teacher whereas, in a more traditional placement, the preservice teacher assists the cooperating teacher. The ALP allowed the preservice teacher to spend eight hours a day in the classroom for two weeks. Since this camp was implemented on the college campus, preservice teachers were assigned classrooms in the education building. They spent one hour in preparation in the morning before the camp started and one hour after school each day for mentor feedback, university professor's feedback, and preparation for the next day. The hours totaled 90 which equaled their total number of hours needed to complete their field experience for both content methods course that they were enrolled in. In the traditional lab which is part of a content methods course in the fall and spring of the year, preservice teachers are assigned to an elementary classroom weekly for 13 weeks. During the 13-week period, preservice teachers spend six hours weekly in the classroom making their total hours for lab approximately 98 hours total for the two methods courses that they may be enrolled in. Even though the preservice teachers in the traditional lab received approximately eight hours more than the ALP, the preservice teachers in the ALP felt more enthusiastic, and interested, and showed positive attitudes towards their teaching in the intense two-week summer science camp because they could see themselves as the teacher with varied responsibilities.

The ALP Model

The ALP provided preservice teachers with the following:

- Preservice teachers were paired with mentors and assigned their classrooms. They had an opportunity to design bulletin boards, arrange classroom seats, and create behavior management plans, set up various writing centers and arts centers.
- Preservice teachers greeted students as they arrived at the school every morning from the bus drop-off location.
- After the general morning activity with all girls in an assembly format, all preservice teachers escorted their students to their classes to start the lessons.

- Preservice teachers were responsible for attendance, and class management in the halls, and additionally, they had to pace themselves with little supervision, facilitate breaks, and prepare for lunch.
- All preservice teachers were observed by a mentor teacher who provided critical feedback about instructional strategies, classroom behavior, and any observed problems.
- Preservice teachers were responsible for restroom breaks and escorting students to lunch.
- After lunch, the preservice teachers would continue teaching and preparing students for the end-of-the-day activities.

As a result of the ALP model, the following resulted:

- Collaborated team teaching
- Effective lesson pacing
- Smooth transitions of students for lunch, restroom, and group activities
- Controlled bus duty morning and afternoon
- Mentor-teacher feedback and collaboration
- Methods professor modeling, scaffolding, and feedback

Research has shown that prior experiences in the classroom have been a powerful influence on elementary teachers' views of teaching (Downey & Cobbs, 2007). The university professors felt that using this model would allow the preservice teachers to gain useful and practical knowledge and thus exude confidence in teaching.

Traditional Lab Model

Traditional field experiences have provided and demonstrated skills in the classroom in the following way:

- The mentoring teacher would explain the classroom management in place, demonstrate inquiry lessons, and provide observation of the dynamics of student-teacher interaction during a teaching episode at the beginning of the experience.
- The mentoring teacher would later hand off more responsibility to the preservice teacher based on awareness of students' characteristics, and experience teaching develops methods of assessing students' learning formally and informally, and begin to reflect on the teaching-learning process.
- Most traditional field experiences encourage preservice teachers to participate in classroom interactions and assist teachers with instructions or activities, the preservice teachers are not given complete responsibility for initiating instruction or maintaining large group instruction.
 - Preservice teachers work in small groups and then build up to a large group.
 - The preservice teacher will prepare and teach a lesson for the university supervisor to observe.
 - The mentoring teacher provides opportunities for the preservice teacher to collect papers, call the roll, grade papers, and assist in lunchroom and morning activities.
- The mentoring teacher may encourage students to apply strategies taught in the methods course but often time they do not have full control of implementing new lessons unless they follow the guidelines of the teacher.
- In some cases, misunderstandings of the lessons or activities may occur between the preservice teacher and the cooperating teacher. Those misunderstandings may cause some difficulty in the field experience process.

In many traditional field experiences, students' learning is limited to management skills such as how to efficiently grade workbooks, and tests, lead a small group instruction, keep students busy with seatwork while leading groups as well as take care of the daily roll, supervise the transportation of students from one place to another, and finally keep track of everyone's work (Shantz, 1995). The important consideration of the traditional

model is to allow preservice teachers to conceptualize how the field experience contributes to learning to teach. It also allows for the development of helping preservice teachers to develop their thinking and classroom practices.

Theoretical Framework

Situated cognition theory (Brown, Collins, & Duguid, 1989) framed this study, because knowing and doing are intertwined in this complex self-study educational context (Holmlund, Lesseig, & Slavit, 2018). Central to this framework is creating a community of practice (CoP) in which the interactions between the participants, and the situation they are experiencing develop new knowledge and understanding (Lave & Wenger, 1991).

According to Brown et al. (1989), situated cognition theory suggests that knowledge is not simply a product of individual cognition, but is rather situated within the social and cultural context in which it is learned and applied. This theory emphasizes the importance of learning and problem-solving in authentic, real-world contexts.

In the context of preparing preservice teachers for teaching science, situated cognition theory can be a valuable framework because it helps to highlight the importance of providing opportunities for preservice teachers to engage in authentic, hands-on experiences that reflect the realities of teaching science in real-world settings. As Novak and Krajcik (2006) explain, these experiences can include opportunities for preservice teachers to participate in authentic scientific research, collaborate with practicing scientists or engineers, or design and implement science lessons in real classrooms.

Furthermore, situated cognition theory can help to promote a more holistic and integrated approach to teacher preparation, by emphasizing the importance of combining both theoretical knowledge and practical experience in meaningful ways. As Lave and Wenger (1991) argue, learning is a social process that involves participation in communities of practice, where individuals engage in authentic, real-world tasks and interact with others who share common goals and values.

Overall, situated cognition theory is a valuable framework for studying and preparing preservice teachers for teaching science, as it emphasizes the importance of real-world experience and contextualized learning, and can help to promote a more holistic and integrated approach to teacher preparation.

Methodology

A mixed methods study was designed to examine the overall science camp. Quantitative and qualitative methods were used to analyze whether rural, African American girls, from a low socioeconomic background increase confidence and knowledge in science; whether preservice teachers' attitudes toward teaching elementary/middle school science improve; and whether preservice teachers' knowledge in teaching science to diverse learners increases. Qualitative methods include interviewing the girls, preservice teachers, mentor teachers, and parents; camp observations, and reviewing the girls' and preservice teachers' daily journals. Descriptive statistics were applied to four sets of pre- and post-instruments that measure: the girls' science knowledge; beliefs about their science abilities; preservice teachers' attitudes toward teaching science; and preservice teachers' attitudes towards teaching diverse learners. For the purpose of this paper qualitative data were collected from the preservice pre- and post-surveys and journals. This information provided the author with surprising data concerning the ALP.

There were 10 preservice teachers who volunteered for the ALP and met the requirements to participate by having been previously enrolled in a science and math method course. At the time of the summer camp, they

were enrolled in a social studies methods course. As part of the preparation for the camp, the preservice teachers met with the social studies methods instructor and the science methods instructor to prepare lesson plans for 60 girls who would be participating in the camp. The preservice teachers worked as co-teachers in the summer science camp classroom and were assigned 12 girls. An orientation meeting was scheduled before the camp started so that the preservice teachers could meet the camp girls, mentor teachers, and parents. The mentor teachers had participated in a workshop during the spring semester that prepared them to observe and provide critical feedback to preservice teachers; communication skills in working with the preservice teachers were implemented to ensure that mentors and preservice teachers would feel free to discuss problems and concerns. The mentor teachers were given a curriculum that included lessons that the preservice teachers would implement in the summer classrooms.

On the first day of the camp, girls, preservice teachers, mentor teachers, and university supervisors were given journals to write down their thoughts about the camp. Surveys were distributed on the first morning of the camp and again on the last day of the camp. Daily journal writing was done in the morning and the afternoon of the camp.

Of the data received several themes emerged about the field experience from preservice teachers as a result of the ALP.

- Prepared to teach
- Not prepared to teach children of color
- Feel confident
- Feel more independent
- Feel positive about teaching
- Increased science interest
- Appreciate mentors
- Feel better teaching social studies
- More positive about the lab experience
- Surprised by students in general wanting to learn science and social studies

Results and Discussion

Eight categories emerged from the preservice teachers' journals. Two major themes included: feeling confident to teach and being comfortable in teaching. Of the 10 preservice teachers, all felt confident to teach after their ALP. They felt more comfortable teaching in the classroom. They all were more positive about teaching. In relation to appreciating mentor feedback and appreciating mentors, a majority showed positively that mentors and mentor feedback was important in the ALP.

Over the entire ALP, the following statements were made by the preservice teachers.

- "I am excited about teaching and I am prepared to teach children of color"
- "I feel better able to teach the science and social studies content"
- "The summer lab placement allowed me to implement new teaching strategies"
- "I feel more confident in my teaching"
- "I experience a better understanding of being in control of my class"
- "I really liked my mentor teacher being in the classroom and allowing me to try new things"
- "I can see that my method's courses are beneficial to my teaching"

- “The work was hard but it gave me a better picture of what teachers deal with on a daily basis”
- “Feedback was critical to my success”
- “I have learned as a teacher that having a positive attitude and passion will have a greater impact on students”

The preservice teachers’ daily journals provided information that addressed the usefulness of the camp experiences as a non-traditional lab. Their journals indicated several positives about the ALP. They enjoyed having their own classroom. They enjoyed co-teaching with respect to having a chance to be supportive of each other. They felt that having full responsibility for the girls in the camp increased their level of decision-making as opposed to the traditional lab experience of observing students and then putting into practice which is what had been learned in their methods. With the ALP they were able to jump right in from the beginning teaching, planning, and preparing lessons. They welcomed the mentor’s feedback because they felt that the mentor listened, provided beneficial advice, and understood the deeply emotional nature of the climate of the classroom by being an observer first and then an advisor second. The mentors helped and did not interfere. The mentors were able to help the preservice teachers’ problem-solving discipline and classroom instruction.

What Can Be Learned From This ALP?

The ALP can be compared to hands-on, on-the-job training in a subject matter. The anxiety about teaching a subject matter decreases and confidence increases after completing the training. The same can be said for lab placements. The confidence increases as preservice teachers have a chance to plan lessons, control classroom behavior, teaching activities, and reflect upon the lessons taught. The ALP reinforces the importance of field experiences. The ALP provided motivation, increased growth development of teaching behavior in the classroom, practical hands-on experience, more positive attitudes toward teaching, and the closest similarity to having their own classrooms to explore and problem solve. A new innovative model is a maturing one for most students. It helps them see themselves as teachers as well as students (Howitt, 2006). For many, this transformation begins with the simple greeting as hearing “Good morning, Ms. Jones”. They come to be treated as teachers and understand the need to act professionally as they interact with students. They also recognize the importance of coming to their classes prepared and knowledgeable. The preservice teachers of the ALP can see this experience as their first step to taking on their future professional role as teachers.

ALP Concluding Thoughts

Much can be learned from this experience. Cooperating teachers and in this case mentor teachers have significantly more interactions with the preservice teachers. Effective communication, planning, and preparation allow opportunities to encourage support and motivation. The preservice teacher when paired with trained and cooperative mentors alleviates haphazard situations that can occur in the classroom. Untrained cooperating teachers have a much greater incidence of having no interaction with the preservice teachers. Although these differences with an untrained mentor teacher are not statistically significant, they are important because they reinforce negative interactions with the preservice teachers (McIntyre & Killian, 1985).

Utilizing a model such as the ALP can provide practical and problem-solving techniques. Some preservice teachers have difficulty in being flexible, dealing with their dispositions, and considering learners’ backgrounds, yet with this model, they learn that every day comes with its own unique problems, and they learn to think on their feet and make quick decisions. They are able to make connections, analyze, trust, and build upon methods of classroom instructional strategies.

Implications

Teacher quality is still the most powerful school-related influence on children's academic performance. As teacher education programs continue with their reform effort to prepare highly qualified teachers, these programs need to focus on developing programs that encourage preservice teachers to obtain knowledge, skills, competencies, and exposure to the classroom. Exposure to the classroom will allow for on-the-job training, with the readiness to teach, willingness to teach, and creative innovation to teach. This paper is not intended as a complete representation of preparing preservice teachers through an alternative laboratory placement, but rather a means of sharing and documenting a new strategy that may be relevant in supporting future teachers. Given the challenges facing teacher education, it is imperative to continue researching a model that will ensure success for the prospective teacher (Barnes, 2006).

Recently as a result of virtual learning during COVID-19 Pandemic, preservice teachers were presented with new and unique experiences in alternative lab settings virtually. A recent field experience study, that was conducted by teacher education faculty, looked at a virtual stem camp where preservice teachers were expected to function as the primary teachers, starting with planning, and organization, all the way through assessment and evaluation.

The common practice of PST field experiences in teacher education programs is intentionally exposing PST to schools under the guidance of program faculty and trained teacher mentors throughout the preparation program (Kennedy & Archambault, 2012). These field experiences are often closely integrated with coursework, assessment practices, and program goals (Hemmings & Woodcock, 2011).

The Virtual ALP Model

The Virtual ALP provided preservice teachers with the following:

- Preservice teachers were then assigned a virtual classroom experience via the Teaching Channel and ATLAS (Accomplished Teaching, Learning, and Schools) websites.
- The 24 students were divided among three university teacher educators and two Ph.D. candidates in elementary education.
- They had an opportunity to utilize online classroom engagements such as virtual classrooms, virtual reading, and research nooks and stations, all geared toward offering parallels to in-person experiences while still attempting to keep at-home students interested and engaged in the new and challenging virtual spaces.
- Preservice teachers created new forms of student and "classroom" management techniques to ensure organization and ways for students to engage and interact at their new comfort levels. Instantaneous and online assessment tools such as Padlet, Whiteboard, Mentimeter, WordClouds, and Classkick were key to gauging student participation.
- Preservice teachers established ways and procedures to actively greet students as they logged in to class sessions daily. Warm-up drills, "Do-Now" activities, and other class starter activities took on electronic formats versus in-person tactile exercises.
- Preservice teachers were responsible for virtual class attendance, class management in the chat, shared communication sites, and tools such as WhiteBoard, Padlet, and ClassKick. Additionally, they had to pace themselves with little supervision, facilitate breaks, and stay on time for coordinated online class transitions.

- All preservice teachers could be remotely monitored by education faculty by sign-in in as an online class participant.

- Mentor teachers can provide critical feedback about instructional strategies, classroom behavior, and any observed problems.

- The virtual ALP ended at lunchtime (12:30), and the preservice teachers had a chance to plan and prepare for the next day with their mentors.

As a result of the virtual ALP model, the following resulted:

- Collaborated team teaching
- Effective lesson pacing
- Smooth online transitions of students for lunch, restroom, and group activities
- Mentor teacher feedback and collaboration
- Methods professor modeling, scaffolding, and feedback

Elementary preservice teachers from a university in southern California who participated in ALP Virtual STEM Camp experienced learning in a variety of ways for presenting science lessons.

This study found that the experience of collaboratively planning, implementing, and reflecting upon a virtual STEM experience led to many changes in perceptions among TEs. They became more aware of the differences in virtual versus in-person learning environments and utilized the lessons learned in their future classrooms with PETs. Future studies from the perspectives of the learners and prospective teachers might provide further insight into the underlying similarities and critical differences between the two settings (Burton, Tripp, Maiorca, Roberts, & Ivey, 2021).

While the global pandemic limited in-person interactions, since the start of the pandemic, online teaching experiences have been on the rise. Virtual field experiences allow preservice teachers to virtually instruct and teach the students while allowing teacher education faculty to observe preservice teachers as they interact with students in their virtual classrooms. To aid in preparation for this, prior to teaching virtually, preservice teachers were assigned virtual classroom experiences via the Teaching Channel and ATLAS (Accomplished Teaching, Learning, and Schools) websites. These sites provide a library of authentic case studies of accomplished teaching practices indexed to common teaching and learning frameworks across a wide variety of classroom settings. The videos from the Teaching Channel and ATLAS were not made exclusively for field observations. The teaching channel videos have been used previously with educational courses to show students interacting with teachers teaching content. Preservice teachers could use the Teaching Channel and ATLAS videos to observe teachers virtually and gain a complete understanding of this new virtual instruction currently being utilized as in-person field visits were obsolete due to COVID-19 restrictions.

Virtual labs were found to play an important role in preparing preservice science and STEM teachers for both in-person and virtual instruction by providing them with opportunities to develop their pedagogical and technological skills.

In virtual labs, preservice teachers could simulate laboratory experiments and explore scientific concepts in a safe and controlled environment. They could also practice their instructional strategies and techniques for teaching science and STEM topics, such as designing experiments, asking open-ended questions, and facilitating group discussions.

By using virtual labs, preservice teachers became more comfortable with the use of technology and learn to navigate the challenges of teaching in virtual environments, such as managing the online classroom, engaging students, and providing feedback. This helped them to be better prepared for teaching in-person and virtually.

Moreover, virtual labs are particularly useful for preservice teachers who may not have access to physical labs or expensive equipment, as they provide a low-cost alternative for delivering high-quality STEM education.

In summary, virtual labs can be an effective tool for preparing preservice science and STEM teachers for both in-person and virtual instruction by allowing them to practice their pedagogical and technological skills in a safe and controlled environment.

Teacher Educator Reflections

Learning occurred in a variety of ways. One TE noted;

I've learned to better facilitate online discourse and to purposefully create a safe space for students to learn online. Some students would rather share in the chat but are still contributing to the conversation in a way they are comfortable.

These varied forms of discourse were unique to the virtual environment but served as proof of students' learning during the lessons.

One TE reflected on feedback received from PETs the following semester, "students appreciated the detail and organization, especially in comparison to their other experiences. I have no doubt that I would not have spent that much time on it had I not had the virtual experience in the summer." This detail and organization provides the consistency of design and process needed to create a virtual learning environment conducive to learning (Asim et al., 2020). Another TE noted, "it has made me more comfortable using technology tools for instruction. It has made me understand the importance of sharing unique and innovative techniques of teaching pedagogy to the preservice teachers so they can use them in their classrooms."

"This TE explained that sharing time at the beginning of class, using the morning meeting format in Jamboard, was something that hadn't been done previously and was an essential element after the virtual teaching experience."

Conclusion

The purpose of the study was to investigate how to best prepare preservice elementary school teachers to teach science autonomously, specifically addressing their concerns regarding their comfort and understanding of how to teach science, particularly STEM-related labs and activities, along with the day-to-day operations of classroom management and logistics. The study aimed to provide preservice teachers with total autonomy and control of their preparation, planning, execution, classroom management, classroom support services, and before and after-class activities to help build their confidence and needed skill sets. The study also sought to explore the effectiveness of an alternative field placement for preservice teachers that is inclusive of all teaching responsibilities that are usually not found in the traditional lab experience.

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