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Persistence patterns among secondary STEM teachers: a comparative study of Noyce scholar cohorts in face-to-face and blended learning environments amid the pandemic

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Noyce scholars were provided funding to compete teaching certification in STEM and earn a master's degree. Then, they were required to teach for 2 years in a Title I school setting. All cohorts were impacted by the pandemic (e.g., university coursework, student teaching and/or teaching was converted to blended learning). This study highlights the differences in teaching persistence across the three cohorts of scholars ($n = 24$) regarding continuance in earning their degrees and completing their two-year teaching obligation. Descriptive case study methodology was used in this comparative study across three cohorts. The primary research question explored how different modalities of initial teaching experiences impact early persistence among secondary STEM teachers. The supplemental research question explored scholars' intention to remain in the teaching profession. Results indicated that the cohort with blended first year teaching experiences had the lowest persistence rate. Generally, scholars intend on persisting in the profession for 6 years or more. Recommendations for practice include the need for more traditional, face-to-face initial teaching experiences and a cohort model for new teachers. Recommendations for research include continued evaluation of Noyce projects, longitudinal studies to track STEM teachers' persistence, and a comprehensive analysis of teacher preparation programs' effectiveness in promoting teacher retention.

KEYWORDS

Noyce scholars, teaching persistence, blended learning, STEM secondary teachers, pandemic (COVID-19)

Introduction

As educational systems continue to deal with the shortage of qualified teachers, it becomes increasingly important to focus on understanding the retention and persistence of those who are already in the profession. The retention of current teachers is critical to addressing the teaching shortage challenge (Carver-Thomas and Darling-Hammond, 2017). Approximately two-thirds of teachers who leave the profession do so for reasons other than retirement, indicating the importance of ongoing support for existing educators (Carver-Thomas and Darling-Hammond, 2019). Moreover, many districts face difficulties in filling Science,

Technology, Engineering, and Mathematics (STEM) positions, making it clear that effective strategies are needed to both recruit new teachers and encourage lasting commitment from those already in the field (Darling-Hammond, 2016). Secondary schools, in particular, experience notable challenges in recruiting and retaining teachers (Cowan et al., 2015).

The teacher shortage is affecting schools nationwide (Nguyen et al., 2022). However, schools in the southwestern United States and those with a high percentage of students of color are disproportionately impacted compared to suburban schools with predominantly white students (Bryner, 2021; Sutchter et al., 2019). To tackle this issue, it is essential to investigate the reasons behind the departure of individuals from the teaching profession and the challenges faced by those who choose not to enter it. Research on persistence in STEM teaching has gained increasing attention, particularly within the context of education initiatives like the Noyce Teacher Scholarship Program (Kumar and Moffitt, 2022). Participants of the Noyce Teacher Scholarship Program who are entering the teaching profession as part of their program are referred to as *scholars*. One aspect of the Noyce program aims to improve the recruitment and retention of STEM educators by providing support to teachers pursuing degrees and certification in these fields (Morrell and Salomone, 2017). While the Noyce program is designed to support teachers, there are continued challenges in meeting their needs while encouraging persistence in the classroom (Smith, 2024). Understanding the factors contributing to the persistence of students enrolled in such programs is important to guide future proposals and programs.

For this study, secondary STEM teachers who were part of a Noyce grant were researched. The scholars already earned a bachelor's degree in a STEM field before admission into the program. They were recruited into the program with the requirement of attaining a Master of Arts degree in Education within the first 14 months of the program. Then, they were required to teach in a Title I school/district for 2 years after completing the degree program. They received a modest stipend to support their completion of grant requirements. There were three different cohorts that entered the program. Cohort I ($n = 3$) started in August 2018; Cohort II ($n = 14$) started a year later (August 2019), and Cohort III ($n = 7$) started in August 2020. All three cohorts were impacted by the regulations and governmental recommendations associated with the pandemic. For example, student teaching or first-year teaching might have been blended, or their education courses may have taken place in a virtual setting.

To understand how these experiences influenced teachers' persistence in meeting program obligations and their commitment to teaching (e.g., completing the master's program and teaching for 2 years in a Title I school), the study examined the impact of student teaching and the initial years in the teaching profession. The primary research question was: *How did different modalities of initial teaching experiences (e.g., face-to-face or blended) impact early persistence among secondary STEM teachers?* To answer this question, yearly outreach to each teacher took place. One supplemental research question was designed to shed light on scholars' perceptions of the teaching profession: *Do scholars intend to remain in the teaching profession after completing their Noyce service obligation?* A short anonymous survey was designed and implemented to measure their notions on persistence in the profession.

In recent years, teacher persistence has been a continuing concern (See et al., 2020; Van Overschelde and Wiggins, 2020). The pressures of

the pandemic likely impacted retention challenges (Bastian and Fuller, 2023; Carver-Thomas et al., 2021; Kraft et al., 2021). There are few studies that focus specifically on the persistence of Noyce scholars in secondary STEM Title I schools, and we could not locate any specifically examining persistence after the pandemic when initial teaching experiences were impacted by social distancing amid the pandemic. Our study is unique in its focus, and we aim to contribute to the existing literature to enhance our understanding of how scholars can be supported in future Noyce projects.

Review of the literature

In the most recent decades, teacher turnover has been more of a concern, impacting the organizational structure of schooling (Ingersoll, 2001; Saks et al., 2022). Teacher turnover is a multifaceted problem that has many different contributing factors and research is often contradictory. For example, in relation to the number of special education students in a school, research indicates that the higher the number of special education students, the higher the teacher turnover rate (Billingsley and Bettini, 2019). Research also indicates that the higher the number of special education students, the lower the teacher turnover rate (Moore et al., 2018). These contradictory findings indicate the challenges of understanding teacher persistence. Research specific to STEM teachers shows a variety of factors that impact retention rates. For example, Suárez and Wright (2019), they found that job satisfaction was the only significant teacher-centered variable that impacted retention. Their findings were in alignment with other studies (Ingersoll, 2001; Shen et al., 2012). However, Suárez and Wright found contradictory results in relation to other factors like the teachers' gender, their education level, and the kinds of students taught; these factors did not impact retention as was the case in other studies (Grissom et al., 2012; Mills et al., 2010). Nevertheless, teacher persistence (or lack thereof) is a stagnate concern in schools that does not appear to be improving (Sutchter et al., 2019; Wiggan et al., 2021).

The Noyce teacher scholarship program

Programs such as the Noyce Teacher Scholarship Program aim to recruit and retain STEM teachers in secondary education Title I classrooms (Alemdar et al., 2018). The program is designed to improve both the quality and quantity of STEM teachers in America's classrooms. The program is designed to address the critical need for recruiting, preparing and maintaining highly qualified STEM teachers in K-12 classrooms. There is a critical need to evaluate through meaningful research the effectiveness and persistence of Noyce scholars (Manier et al., 2022). There is a push to promote more research-based approaches to Noyce programs that include the evaluation of the effectiveness of programs and what can be done to improve the retention and success of Noyce program recipients (e.g., scholars and master teacher fellows). For example, Ekmekci et al. (2025) researched how master teacher fellows were supported to take on leadership roles in the field of education and what factors led to persistence and shifts to leadership. They found that support and networking were critical elements in supporting Noyce master teacher fellows as they shifted persisted in teaching and/or transitioned to leadership positions.

The persistence of teachers, particularly teachers in STEM fields and in Title I schools, is a national concern (Sutcher et al., 2019) and the Noyce program helps to address it. Marder et al. (2022) reviewed the Noyce scholarship program in Texas using a state longitudinal dataset. Their findings indicated that Noyce scholars are more likely to teach marginalized students and that their students achieve higher value-added scores in mathematics compared to those taught by non-scholar teachers. However, Noyce scholars tended to leave the teaching profession earlier and were more inclined to leave Title I schools.

Nevertheless, other studies have identified benefits to the Noyce program. Smith (2024) evaluated the strengths and challenges of the Noyce program and found that Noyce scholars believed the program supported their ability to effectively teach STEM content, and they were thankful for their experiences that led to their growth as teachers. Bischoff et al. (2014) found that scholars in New York City showed that approximately 70% of scholars voiced positive perceptions of their teaching communities and their ability to meet students' needs. The remaining scholars voiced negative perceptions of urban teaching and their ability to meet students' needs. While not all Noyce scholars complete their service obligations, the program has been shown to have an overall positive effect of teacher preparation programs in high need schools (Kumar and Moffitt, 2022).

Due to the pandemic, there were challenges to the Noyce program and other new teacher programs beginning in early 2020 and beyond. Pre-service teachers were forced to change how they experienced student teaching and their programs of study (Masterson et al., 2024). Novice teachers were forced to teach in a blended format with little to no preparation (Akojie et al., 2022). While teacher preparation programs often embrace various formats (e.g., virtual, face-to-face and/or blended) to prepare teachers (Thompson et al., 2013), the pandemic forced immediate changes for which pre-service and in-service teachers were not prepared (Akojie et al., 2022; Masterson et al., 2024; VanLone et al., 2022).

The pandemic had a negative impact on teacher persistence, further exacerbating the problem (Saks et al., 2022). For example, in California the pandemic negatively impacted teacher supply with increased resignations, retirements and turnover rates (Carver-Thomas et al., 2021). Bastian and Fuller (2023) researched educator mobility during the pandemic in North Carolina. They found that mobility increased from 2020 to 2022, likely because of the pandemic. This increased turnover highlights a critical issue in education with a need to understand the factors influencing teacher persistence.

Modes of teaching

With the advent of technology, there are a multitude of ways to teach curriculum, from blended modes that include face-to-face on technology-based approaches to one mode instruction (e.g., only face-to-face or only online). Regarding online learning versus face-to-face learning, Wang and Wang (2021) explored the impact on social and cognitive presences. They found that students who were in a face-to-face or synchronous group outperformed all other groups. Their study indicates the importance of providing opportunities to interact with peers to promote community building. Soffer and Nachmias (2018) explored the differences between face-to-face and online classes. They found that students in the online courses reported a

clearer understanding of the course structure, improved communication with the course staff, increased views of the video lessons, and higher levels of engagement and satisfaction. There are also studies that show that synchronous online interactions are more positive than asynchronous online interactions (Peterson et al., 2018; Saltarelli and Roseth, 2014). With each approach, there must be a careful, focused implementation of curricular methods to meet the needs of the instructor and students (Beatty, 2019). However, the pandemic required a sudden transition that did not allow for a careful implementation of blended or technology-based learning methods. Detangling specific online experiences to measure, research or evaluate through blended learning is extremely difficult, if not impossible (Bernard et al., 2009). The pandemic made it even more challenging because there was a forced, unexpected switch to blended mode. In addition, part of online engagement includes cognitive and emotional engagement (Halverson and Graham, 2019); likely both of cognitive and emotional engagement were also impacted by the pandemic.

This research is designed to address gaps in the current research by closely examining persistence within the Noyce program. Due to the structure of the Noyce project researched, three cohorts were impacted by the pandemic in different ways. Specifically, student teaching and/or initial teaching experiences were altered and changed due to pandemic related restrictions. This research closely examines persistence among the cohorts using yearly participant responses to surveys. In addition, a survey to examine whether scholars intended on staying in the teaching profession is evaluated. By examining the unique challenges faced by each cohort, this study aims to provide valuable insights into the factors influencing persistence in the Noyce program. A more nuanced understanding of how external disruptions, like the pandemic, impacted teacher retention and preparation is provided. Addressing this gap is crucial for developing targeted interventions that support future educators in navigating similar challenges.

Methodology

This comparative study examined three different cohorts of different sizes. Descriptive case study methodology was used to explore the scholars' persistence across the cohorts using mixed methods. By examining the differences and similarities in teacher persistence across these modalities and pandemic experiences, this research sought to provide insight regarding the initial teaching experience factors that influenced teacher persistence in secondary STEM education. There was a specific focus on the modes of initial teaching experiences as related to the pandemic and the completion of project related obligations, as well as participants' perceptions of why they were likely to persist as teachers.

Due to the nature of descriptive case study methodology and the small number of participants ($n = 24$), survey and interview data were collected throughout the years. For example, scholars filled out a simple survey every year stating the school they worked in, whether they completed the full year, and what subjects and grade levels they taught. They had to supply supplemental paperwork (e.g., their teaching contract, paycheck stub) as well. Some scholars opted to talk with the external evaluator for a voluntary interview. As well, members of the project team observed them in their student teaching

placements. We sought to gather descriptive information regarding our related research questions.

Participants’ Noyce program

The participants were part of the Track I Noyce scholarship program. Track I aims to encourage STEM majors and professionals to become K-12 teachers by providing scholarships and stipends for students who teach in high-need school districts after completing their education. Through this initiative, participants are expected to enhance student learning and engagement in STEM subjects. To be eligible to participate in our project, scholars had to already have a bachelor’s degree in a STEM field. Recent STEM graduates were funded to earn a master’s degree plus certification in 14 months. Their program of study started in the summer and concluded at the end of the summer the following year. Once they concluded their education and received their certification and master’s degree, they were supported through mentoring and professional development experiences.

Recruitment consisted of advertising through social media and university groups with a link to the application. We also worked with advisors to identify potential applicants. In alignment with Noyce requirements, scholars must: (1) be citizens, nationals, or permanent resident aliens of the United States; (2) possess a bachelor’s degree in a STEM field. Each March, we interviewed all qualified applicants for the start of our program in May. A team of project personnel and district personnel interviewed and scored each applicant. The applicants with the highest scores were invited into the program. To be admitted into the program meant that scholars would enter a master’s program while simultaneously pursuing their teaching certification. We provided scholars with training in evidence-based practices and placed them in high-need school districts. After completing their degree, they were required to teach for 2 years in a high-needs school, or they would have to pay back their funding.

Program of study

The master’s and certification were housed in the education department. A signature feature of this program was the residency component where teacher candidates were placed in partner districts for an entire school year, which is combined with on-site classroom instruction in pedagogy, content, and dispositions from faculty. There were five key components of the model: (1) integrating theory and practice (during residency, teacher candidates fully integrate coursework while co-teaching in a classroom at a partner school); (2) emphasizing student achievement (teacher candidates benefit from frequent, focused feedback throughout the program using a research-based rubric); (3) site coordinator supervision (a district embedded faculty member serves as a liaison between the local school and the university, ensuring that the programming is serving all parties at the highest level); (4) applying a co-teaching model (a mentor teacher and preservice teacher will partner to plan and deliver academic content in a variety of formats; and (5) building professional partnerships (collaborative supervision and mentoring are hallmarks of the program—faculty, mentor teachers, district specialists, and administrators work together to prepare program graduates to be effective teachers). The program was designed specifically to address the distinct challenges faced by low-income, high-minority

schools. It incorporated coursework and clinical experiences that enhanced both teaching methods and practical skills. During the summer, scholars engaged in courses that equipped them for the culturally and linguistically diverse environments of their host districts before they embarked on their initial clinical experiences. Culturally infused pedagogy is recommended to support Noyce participants in their teaching journeys (Kumar et al., 2025).

Program supports

As with all Noyce programs, our scholars were provided with additional supports. In relation to their student teaching, they were provided with a STEM education mentor from the university who helped them navigate through the initial teaching experiences. This mentor met with the scholars numerous times throughout the academic year and served as a liaison when issues arose. For example, one scholar was given five different classes to teach, all different subjects. The mentor stepped in and worked with two school districts to find a placement that was more supportive of a novice teacher. In addition, the scholars were provided with individualized professional development experiences to support their learning. For example, when the scholars voiced concern over their classroom management skills, they were offered three different professional development experiences on classroom management. Moreover, scholars were provided opportunities to attend professional development courses of their choice offered by local non-profits, universities and other Noyce projects.

Participants

People with an earned STEM bachelor’s degree and lived in the Phoenix-metropolitan community were recruited into the project. Each year, applicants were interviewed. After interviews were complete, 24 total scholars were admitted into the project. Table 1 offers an overview of scholars’ demographics, rounded to the nearest percent. The scholars entered the project during the summer and

TABLE 1 Participant demographics (n = 24).

| Demographics | Percent |
|---------------------------|---------|
| Gender | |
| Female | 67% |
| Male | 33% |
| Race | |
| Asian | 4% |
| Black or African American | 8% |
| Hispanic/Latinx | 25% |
| White | 58% |
| Two or more races | 4% |
| STEM majors | |
| Science | 75% |
| Engineering | 8% |
| Mathematics | 8% |
| Other | 8% |

completed a certification and a master's degree program in about 14 months. They were then required to immediately teach for 2 years in a Title I school or district. District start and end dates varied, therefore timeframes are approximate. Districts could choose how they wanted to deliver curriculum to students during the pandemic—there were no state mandates or requirements. Therefore, there was inconsistency and variation in modes throughout the academic year for scholars, designated by the term *blended* in Table 2.

All scholars were student teaching and teaching in Title I schools. Data collected during the Spring 2021 semester show the diversity of scholars' placements, see Table 3 (Arizona Department of Education, Health and Nutrition Services, 2023; National Center for Education Statistics, 2021). Throughout, scholars are referred to using gender-neutral pronouns (he/she) to maintain confidentiality. Data are provided for all teachers who persisted in the classroom during the Spring 2021 semester.

Data collection and analysis

To answer the primary question, *How did different modalities of initial teaching experiences (e.g., face-to-face or blended) impact early persistence among secondary STEM teachers?*, qualitative survey data were collected through email contacts with the scholars at the completion of each academic year (from approximately March to June each year). Data were then analyzed using descriptive coding to comply with Noyce program requirements to track scholars' persistence and compliance (Gibbs, 2007; Saldaña, 2021). Descriptive coding is a qualitative data analysis technique used to summarize data in order to provide a concise summary by identifying characteristics. For example, the scholars were asked if they were still teaching, and if not, why they left the classroom. They were asked what their school district and school name. Using this information, project personnel looked up the school and district demographic information, location and Title I status. Then, the scholars' schools and districts were categorized into like placements. If the scholar was no longer teaching, follow up by project personnel occurred. Descriptive coding was a well-suited methodological approach and provided insight based on

the communications of the project leads with the scholars. Descriptive coding was well-aligned with this research because it assisted in data organization and was flexible due to the iterative nature; we were able to redefine codes as needed. Because the total number of participants was so small ($n = 24$), and the number of scholars in each cohort was so small ($n = 3$ for Cohort I, $n = 14$ for Cohort II $n = 7$ for Cohort III), it is not possible to test for statistical significance. Therefore, in presenting the data, we focus on the descriptive statistics and provide percentages for each cohort to illustrate the relative distribution and trends within the groups, rather than relying on inferential statistics to draw conclusions about significance.

In defining the modes of instruction, the state of Arizona allowed districts to decide how they would address teaching and learning during the pandemic. There was no consistency across districts or schools. For example, a school might have face-to-face instruction for 1 month, and then transition to synchronous learning for another month, then transition back to face-to-face instruction. Another school in that same community might have varying modalities. The university allowed students to decide if they wanted to attend face-to-face, synchronously attend or participate in only online learning. Some students attended face-to-face for 3 weeks, then, by choice, attended online for the rest of the semester. Therefore, the term "blended" is used here to describe teaching and learning experiences that took place during the pandemic and were not solely face-to-face.

An anonymous survey was administered by the external evaluator to answer the supplemental research question: *Do scholars intend to remain in the teaching profession after completing their Noyce service obligation?* The survey was administered to scholars using Qualtrics and analyzed using descriptive coding by the project's external evaluator during the 2022–2023 school year. The survey was completed by 10 scholars. The survey, which drew upon the National Center for Education Statistics Teacher Follow-up Survey (2022), included questions on teachers' perceptions of persistence and reasons for their likely persistence to better understand the reasons why scholars were likely or unlikely to remain in the teaching profession. The first set of questions consisted of four prompts that asked the scholars to rate their persistence on a scale: almost always, often, sometimes, or almost

TABLE 2 Teaching and learning modalities across cohorts and program phases.

| Cohort | Entrance into certification and master's program | Completion of certification and master's program | Student teaching | | First year teaching | | Second year teaching | |
|---------------------------|--|--|------------------|--------------------|---------------------|--------------------|----------------------|--------------------|
| | | | Mode | Dates (month/year) | Mode | Dates (month/year) | Mode | Dates (month/year) |
| Cohort I ($n = 3$) | Summer 2018 | Summer 2019 | Face-to-face | ≈ 8/18 to 5/19 | Face-to-face | ≈ 8/19 to 3/20 | Blended | ≈ 8/20 to 5/21 |
| | | | | | Virtual | ≈ 3/20 to 5/20 | | |
| Cohort II ($n = 14$) | Summer 2019 | Summer 2020 | Face-to-face | ≈ 8/19 to 3/20 | Blended | ≈ 8/20 to 5/21 | Face-to-face | ≈ 8/21 to 5/22 |
| | | | Virtual | ≈ 3/20 to 5/20 | | | | |
| Cohort III ($n = 7$) | Summer 2020 | Summer 2021 | Blended | ≈ 8/20 to 5/21 | Face-to-face | ≈ 8/21 to 5/22 | Face-to-face | ≈ 8/22 to 5/23 |

Virtual = only synchronous or asynchronous online learning with no face-to-face interactions. Blended = combination of face-to-face, hybrid, and/or virtual teaching.

TABLE 3 Average student demographic profile of cohorts.

| Cohort | High needs title I status | % of Students participating in free or reduced-price lunch program | % of Students from minority groups often underrepresented | | |
|-----------------|---------------------------|--|---|------------------------------------|----------|
| | | | African American | Native American or Native Hawaiian | Hispanic |
| Cohort I | Yes | 74.5% | 5.5% | 2.8% | 80.1% |
| Cohort II | Yes | 61.1% | 13.1% | 2.0% | 53.3% |
| Cohort III | Yes | 59.2% | 8.3% | 13.0% | 60.9% |
| Overall average | | 64.9% | 8.9% | 5.9% | 64.8% |

never. The four prompts were: (1) I feel like continuing in my current teaching position for this entire school year; (2) I feel that I will continue in the teaching profession for the next school year; (3) I feel that I will still be a teacher during the 2024–25 school year; and (4) I feel that I will still be a teacher during the 2025–26 school year. These prompts were designed to measure perceptions of persistence, not actual persistence. A second set of questions asked the scholars to identify reasons for their likely persistence in teaching. They selected reasons for persistence based on given choices including: (1) can work relatively close to my home; (2) cannot think about moving into other jobs or professions right now; (3) enjoy working with students; (4) feel like I am making a difference for students; (5) feel supported as a teacher by school administration; (6) feel supported by parents and community; (7) have a schedule that accommodates caregiving and family life; (8) have invested time and resources in becoming a teacher; (9) have job security; (10) have supportive relationships with other teachers; (11) have teacher autonomy and the desired control over my classroom (12) know I can find a job at another school if I leave my current one; (13) receive a level of salary and/or benefits that are important to me; and/or (14) other. Data from the supplemental research question and corresponding anonymous survey data were not connected to scholars’ specific cohort to protect their anonymity. For example, if only one scholar from Cohort I participated in the survey, they could be more easily identified. IRB permission was received, and scholars consented to participate in the study.

Results

Findings are presented relating to the two research questions concerning the persistence of Noyce scholars in the teaching profession. Specifically, the primary research question evaluated the face-to-face or blended modes of university instruction, student teaching, and first- and second year teaching in relation to persistence in completing grant obligations. The supplemental research question asked scholars to provide reflective feedback regarding their likelihood of persisting in the teaching profession.

Primary research question

Cohort I completed their certification and master’s degree program and entered their first year of teaching in the summer of

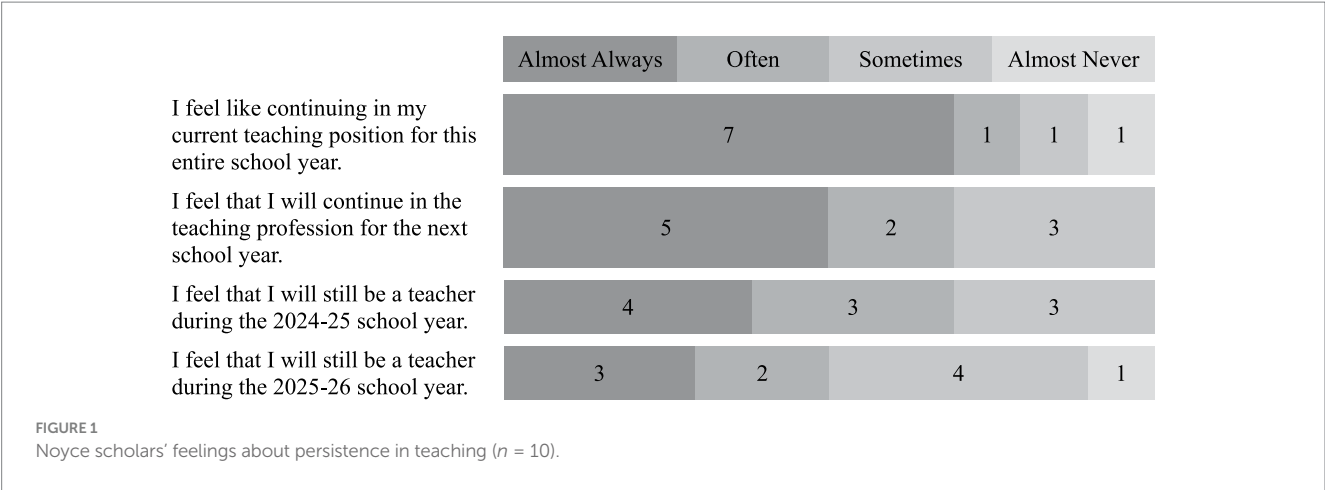
2019. Cohort I ($n = 3$) resulted in 100% of scholars completing their degrees and their two-year teaching obligation. Cohort II ($n = 14$) started their first year of teaching in the summer of 2020 and struggled the most with persistence with a 64% ($n = 9$) completion rate. Of the Cohort II scholars, one scholar did not complete his/her degree and never entered the teaching profession. Additionally, four scholars did not complete their second-year teaching obligation. Of those four, three scholars left the profession; and one scholar taught outside of STEM in his/her second year, then left the profession. One scholar received a deferment, then completed his/her teaching commitment the next year—he/she is included as a scholar who persisted. Cohort III ($n = 7$) began their first year of teaching in the summer of 2021 and resulted in an 87% completion rate ($n = 6$). The scholar that did not complete the required obligations did not complete his/her degree and never entered the teaching profession.

The scholars’ overall completion rate across the three cohorts of the required obligations (i.e., completion of certification and master’s degree and a two-year STEM teaching requirement in a Title I school or district) was 75% ($n = 18$). The cohort specific completion rates were higher than the overall completion rate for Cohorts I and III, while Cohort II had a completion rate that was 14.7% lower than the overall completion rate.

Supplemental research question

Scholars’ perceptions of their likelihood of persisting in the teaching profession can be seen in [Figure 1](#). Some scholars had thoughts about leaving the teaching profession during the next few years. When evaluating future persistence in the teaching field half of the scholars felt “often” or “almost always” like they will be still teaching during the 2025–26 school year.

To assess the likelihood that teachers would leave teaching they were asked: “How likely are you to be a classroom teacher for a total of six or more years after receiving your master’s in education degree?” Out of the ten who responded, all but one of the scholars responded that they are likely ($n = 6$) or very likely ($n = 3$) to persist in teaching for six or more years in total. Only one scholar felt unlikely to persist for this length of time. All scholars who said they were likely or very likely to continue teaching for six or more years cited their investment of time and resources in becoming a teacher. Most also cited their enjoyment of working with students and feeling like they are making an impact. Support in their school from teachers and school administrators had an influence on staying for some scholars as did teacher autonomy and job security. The response frequencies



associated with other reasons are listed in Table 4. The scholar who felt unlikely to persist in teaching indicated the following reasons for leaving: lower salary than is needed and desired, student behavior problems, dissatisfaction with support from school administration, students' lack of interest in learning, insufficient support from other faculty, excessive number of tasks and duties in addition to teaching, large class sizes, and the role of standardized testing in assessing teaching and student achievement.

Discussion

The results of this study highlight significant disparities in the completion rates and persistence among our three cohorts of Noyce teacher scholars, providing insights into their experiences in the teacher preparation and initial teaching experiences. Cohort I achieved a 100% completion rate, highlighting the effectiveness of their traditional educational experiences as they transitioned into teaching roles. In contrast, Cohort II faced notable challenges, with a completion rate of only 64%. Cohort III showed an improved completion rate of 87%, suggesting potential gains in resilience or support systems since the prior cohort. The supplemental research question on scholars' perceptions regarding their likelihood of remaining in the profession mirrored widespread concerns among educators about sustainability and satisfaction in the field amidst ongoing challenges (Berry et al., 2021).

The results showed that the most challenging year of the pandemic (2020) had an impact on completion rates and retention for the scholars in this study. Cohort II had the lowest completion rate and was more impacted by the pandemic in relation to student teaching and first year teaching. Cohort I was mostly impacted by the pandemic during scholars' second year of full-time teaching—all completed their project obligations. While Cohort II scholars participated in student teaching (or taught in a team teaching situation) face-to-face (until about March, 2020), their first year of teaching was predominantly blended and their completion of project obligations was the lowest among the cohorts. Cohort III student taught in a blended environment, but had a mostly traditional, face-to-face first and second year of teaching experiences. While we could not test for statistical significance due to the limited number of participants, we concentrated on descriptive statistics and offer percentages for each

TABLE 4 Top reasons for persisting in teaching for six or more years.

| Reasons for persisting | # of Responses | % of Responses |
|--|----------------|----------------|
| Have invested time and resources in becoming a teacher | 9 | 100% |
| Enjoy working with students | 8 | 89% |
| Feel like I am making a difference for students | 8 | 89% |
| Have supportive relationships with other teachers | 7 | 78% |
| Have teacher autonomy and the desired control over my classroom | 6 | 67% |
| Have job security | 6 | 67% |
| Feel supported as a teacher by school administration | 5 | 56% |
| Can work relatively close to my home | 4 | 44% |
| Have a schedule that accommodates caregiving and family life | 4 | 44% |
| Receive a level of salary and/or benefits that are important to me | 3 | 33% |
| Know I can find a job at another school if I leave my current one | 3 | 33% |
| Cannot think about moving into other jobs or professions right now | 2 | 22% |
| Other | 2 | 22% |
| Feel supported by parents and community | 1 | 11% |

cohort to demonstrate the relative distribution and trends within the groups, rather than using inferential statistics to determine significance.

Our research also showed that scholars in our study are considering leaving the teaching profession. While our findings are not generalizable due to the small number of participants and the unequal distribution of scholars among cohorts, they mirror other studies. The feelings experienced by the Noyce teacher scholars are shared by many educators, as over half of current teachers are

considering an earlier exit from the profession than they had originally planned (Jotkoff, 2022). Teacher turnover is a nationwide challenge, with Arizona facing particularly high rates. Teachers in Arizona are more likely to express intentions of leaving, and data indicate that they follow through on this, with one in four Arizona teachers (24%) either quitting or transferring to different districts each year, compared to a national average of 8% (Sutcher et al., 2019). This turnover has been shown to have detrimental effects on student achievement (Rivkin et al., 2005).

Despite voicing a possibility of leaving the teaching profession, scholars in our study found reasons to persist. Four survey responses were indicated by at least 75% of scholars as reasons to continue teaching. They felt they would persist because they: (1) invested time and resources in becoming a teacher; (2) enjoy working with students; (3) feel like they are making a difference for students; and (4) have supportive relationships with other teachers. This sentiment is echoed in the literature, where studies highlight that emotional investment, job satisfaction, and collegial support are critical factors in teacher retention (Ingersoll, 2001; Skaalvik and Skaalvik, 2010).

Recommendations for practice

The scholars in our study who had the most inconsistent face-to-face teaching experiences during student teaching and their first 2 years of teaching were more likely to abandon their goals of working in the teaching profession. If face-to-face teaching experiences are not possible (e.g., pandemic or other concerns), beginning teachers will need much more support than is traditionally provided. While a plethora of supportive training and professional development opportunities were offered to scholars, they were offered virtually (due to the pandemic) and most were not able or willing to commit to more virtual teaching/learning screentime. By the time traditional, face-to-face classroom experiences resumed, scholars had already left the profession with no intentions of returning. There is not an easy solution; but the research findings as related to our scholars highlight the need for continued support for beginning teachers whose initial experiences are non-traditional. Diab and Green (2024) examined the support systems that contribute to the resilience and success of novice Israeli teachers. They highlighted the importance of both formal and informal networks. Their research illustrated how external support interacts with intrinsic motivations based on self-determination theory, ultimately emphasizing the need for comprehensive induction programs that cater to emotional, psychological, and professional demands. Our results presented here echo Diab and Green's findings, although our results are not generalizable due to the small sample size and the specific challenges faced as related to immediate blended learning and teaching experiences caused by the pandemic.

Teacher preparation programs should continually monitor novice teachers' progress and adjust programs of study and initial teaching experiences (Ingersoll and Strong, 2011). While the pandemic-related transition to blended learning was immediate and without warning, a concerted effort to monitor the transition and make subsequent program adjustments likely would have benefitted participants (Šinko et al., 2024). Šinko et al. (2024) recommend iterative, evaluative check-in points with novice teachers that lead to immediate adjustments in the program based on the outcomes observed.

Ignoring the need for changes likely diminishes effectiveness of check-ins.

Recommendations for future research

Continued research on the Noyce program is needed. Studies that have a small number of participants are more common when evaluating the Noyce program. There are currently a limited number of studies on Noyce projects; further research to evaluate Noyce projects is needed. For example, Ticknor et al. (2017) evaluated a Noyce project using only nine participants and two case studies. Because of the nature of the program (e.g., a limited number of participants and scholarship funds per project), the number of participants in studies is also often limited. Future studies should explore data across several Noyce programs with a more robust number of participants across multiple projects. Possible research topics could investigate the impact of the Noyce program on ongoing persistence, the leadership roles taken on by Noyce scholars, and ways in which Noyce projects can be modified to better serve the needs of educators and their students. The Noyce program is structured to offer ongoing supports for scholars (Smith, 2024). Rhemer et al. (2024) conducted research on Noyce scholars' persistence across five different programs throughout the United States. They evaluated the five programs and collecting instructional tasks and employment data from 46 graduates revealed that all participants could design and implement instruction with moderate to high rigor. Post-bachelor graduate programs showed higher persistence in their teaching careers compared to those from bachelor programs. Studies like Rhemer et al.'s (2024) are fruitful in pointing out components of Noyce programs that can support persistence. While we included project supports (previously described), we did not specifically measure how these project supports impacted persistence. Future studies might explore how these supports impact persistence and student growth.

More longitudinal studies across multiple states could better contextualize persistence in teaching. Persistence in teaching is multifaceted—and often defined simply as a teacher continuing to teach (Wong and Luft, 2015). However, growth and movement are a part of most teachers' employment trajectories and where teachers are employed after leaving the profession is a critical component of persistence research (Buchanan, 2010). Longitudinal studies that monitor teachers' employment trajectories can shed light into whether teachers are still contributing to education in other ways. Along with surveys, periodic interviews and other qualitative data can support a more dynamic understanding of persistence within teaching. In our study, we monitored the scholars up until the conclusion of the project. Further monitoring over a longer period of time could increase our understanding of persistence. For example, one of the scholars left the teaching profession for a break, with the intention of returning. Scholars like this should be monitored and mentored to see if reentry into the profession is possible (Manier et al., 2022).

University teacher preparation programs should be leaders in exploring how their programs impact teacher persistence and perseverance. If teacher preparation programs took a proactive stance and continued to stay connected with their graduates, they could provide invaluable information regarding factors and features that led to persistence (Cenberci and Beyhan, 2016; Kim and Corcoran, 2018). Nuanced and comprehensive evaluations of teacher preparation

programs and evaluations of teachers' initial school placements should be more thoroughly evaluated. There could be program or placement features that are a direct result of teachers' lack of persistence. For example, Cohort II was the only cohort that was part of a team model that included additional pay while omitting traditional student teaching. Cohort II had the highest percentage of teachers who quit the profession. While data regarding the impact of this specific program was not gathered in this study, a more detailed evaluation of the impact of this program features on persistence could shed light. More focused and exhaustive research evaluating program features should be part of teacher persistence research.

Limitations

A limitation of this study is the variability in learning and teaching modes experienced by the three cohorts, which likely impacted the overall assessment of their educational experiences. There is no way to effectively isolate the face-to-face/blended experiences and the pandemic-related experiences that likely impacted the scholars' persistence (Bernard et al., 2009). With a variety of instructional delivery methods and differing district policies and modes of classroom teaching, there were inconsistencies in how the cohorts engaged with their coursework, mentors and students. In addition, there were differences in the number of teachers in each cohort. These discrepancies influenced the ability to draw generalizable conclusions about the effectiveness of the program's modalities and related persistence.

Another limitation was the variance in the programs of study across each cohort. For example, Cohort I followed a strict cohort model in which all teachers transitioned through the program together, taking all of their classes at the same time and with one another. Cohort II and III experienced some inconsistencies in their cohort model. In another example, Cohort II included participants who went directly into teaching without any student teaching experiences; this was a paid induction model that put uncertified teachers in the classroom with limited mentor teachers. Student teaching is a critical part of a teacher's development (Hobson et al., 2008; Peiser et al., 2022); bypassing student teaching likely had a negative impact on Cohort II. The differences in the experiences of the cohort likely impacted the results of this study as well.

Due to the nature of the Noyce program and funding limitations, the sample size for this research was relatively small ($n = 24$), which represents a significant limitation of the study. A small sample size can restrict the generalizability of the findings and does not accurately reflect the broader population (Lakens, 2022). While the study may provide valuable insights, caution should be exercised in interpreting the results and applying them beyond the context of this specific sample (Boddy, 2016).

Conclusion

The purpose of this study was to explore how different modalities of initial teaching experiences influence the persistence of secondary STEM teachers in high-need, Title I schools. The scholars in both Cohorts I and III, whose experience was mostly face-to-face, were more likely to complete their certification and teaching commitments than Cohort II, which experienced challenges due to the predominantly blended teaching demands during the pandemic.

These results suggest that more traditional, stable face-to-face teaching modalities may be better suited to support early-career teachers, especially those working in high-need Title I schools, by nurturing their resilience and commitment in this project with these particular scholars. While face-to-face teaching modalities may have been most beneficial, if online teaching is going to be used there needs to be opportunities to interact with peers (Wang and Wang, 2021).

As with much of the research conducted during the pandemic, there is no way to isolate the emotional and physical toll of the pandemic on our scholars' teaching and learning experiences and teachers in general (Kotowski et al., 2022; Lizana et al., 2021). In addition, there were online and blended learning experiences that were not well planned for or developed, and these experiences were critical components of the scholars' teacher preparation program. Nonetheless our research shows scholars that student taught during the start of the pandemic (Cohort II) were more likely to leave the teaching profession. Because of the small sample size and the limited ability to isolate the pandemic from the scholars' experiences, the results have very limited generalizability. Further studies are needed to see if this is a trend across other Noyce cohorts or an anomaly of the scholars in this study (Manier et al., 2022). With the limited amount of research studies on Track I Noyce scholars (Kumar et al., 2025), we hope that this descriptive case study is able to contribute to the growing research in this specialized area of research.

Data availability statement

The datasets presented in this article are not readily available because the participant numbers are too small to share the data set. Requests to access the datasets should be directed to terri.kurz@asu.edu.

Ethics statement

The studies involving humans were approved by Arizona State University's IRB STUDY00007428. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

TK: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing. TG: Data curation, Funding acquisition, Writing – review & editing. JC: Writing – review & editing. MN: Data curation, Formal analysis, Investigation, Writing – review & editing.

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Conflict of interest

MN was employed by Nation Consulting.

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Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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