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The Impact of Internship on Undergraduate STEM Students' Interest in STEM Teaching

Kristin Cook
Bellarmine University

Akhtar Mahmood
Bellarmine University

Cody Nygard
Bellarmine University

Mira Gentry-Johnson
Kentucky Science Center

Mellisa Blankenship
Kentucky Science Center

ABSTRACT

STEM teachers are considered one of the most important factors in inspiring high school students in STEM to excite them about the dynamic nature of the STEM fields (PCAST, 2010). Increasing the number of qualified and diverse science and mathematics teachers, especially those working in high-need areas, is of paramount importance. The intention of this mixed methods study was to consider the ways in which a teaching-focused internship might impact an undergraduate STEM student's decision to consider entering the STEM teaching profession. Results indicated internships were an important recruitment tool for STEM majors to consider a career in science and/or mathematics teaching. Authors detail implications for supporting STEM interns at all points of their development as a teacher.

Keywords: internships, teacher recruitment, STEM

Introduction

Over the past two decades there has been much concern about the state of K-12 STEM education, instruction in the public school system, and its ripple effect on the future of the STEM workforce, US economic growth, and competitiveness in a global marketplace (Matthews, 2007). The quality of STEM teachers is increasingly recognized to be a critical factor, since teachers have a measurable impact on students' learning, success, and achievements (National Research Council (NRC), 2010; President's Council of Advisors on Science and Technology (PCAST), 2010). Indeed, STEM teachers are considered one of the most important factors in inspiring high school students in STEM to excite them about the dynamic nature of the STEM fields (PCAST, 2010). Highly qualified teachers lay the academic groundwork in STEM, thus inspiring and motivating K-12 students to major in a STEM field.

The demand for certified STEM teachers nationally has been rising, with schools across the country struggling to fill openings with qualified teachers. Fewer STEM students are entering the teaching profession, and school districts are struggling to attract and retain teachers (Barth et al., 2016). Compounding the problem, as public-school enrollments become increasingly diverse and the number of minority students enrolled is growing faster, with students of color comprising nearly half of the student population, the demographic composition of teachers has changed little (Almy & Theokas, 2010). In addition, teacher candidates do not reflect the demographic make-up of students in today's classrooms (American Association of College of Teacher Education (AACTE), 2013). Additionally, schools in high-poverty communities often do not have qualified STEM teachers or have teachers who teach outside of their certification fields. Classes in high-poverty schools are twice as likely to have an out-of-field teacher, compared to low-poverty schools. Moreover, out-of-field teachers are disproportionately teaching minority students and are assigned to teach students in high-poverty schools (Almy & Theokas, 2010). For these reasons, increasing the number of qualified and diverse science and mathematics teachers, especially those working in high-poverty areas, is of paramount importance.

Some states are experiencing these trends more than others and our study focused on the state of Kentucky, where the need is critical. The number of certified Kentucky high school STEM teachers in Math, Biology, Chemistry, and Physics has been declining at an alarming rate since 2010 (Department of Education, 2022). Due to the STEM teacher shortage in Kentucky, the vast majority of high school STEM teachers are teaching outside of their respective certified STEM discipline. Many districts across the state have an extensive shortage of teachers in the STEM fields. Several schools often have only one STEM teacher who is responsible for teaching all the STEM courses, and many of these teachers do not have the certification to teach in a specific STEM field. In order to meet the growing state and national STEM needs, barriers to interest in the STEM teaching profession, such as the perception of low pay and the difficulty of working with students, need to be considered.

In Kentucky, 34.8% of STEM teachers are currently certified to teach middle school Mathematics and 26% are certificated to teach high school Mathematics. Only 4.5% of high school STEM teachers have certification in Chemistry and only 3.3% in Physics. Since 2010, there has been a 44% decline in the total number of certified middle and high school STEM teachers in Kentucky. According to the latest Department of Education's report on nationwide teacher shortages, Kentucky reported teacher shortages in the STEM fields (Department of Education, 2022). There is an urgent need to increase the number of new certified teachers in Physics and Chemistry in particular, since high school Physics and Chemistry courses are often taught by teachers out of their area of certification who do not have a degree in either Chemistry or Physics. In recent years, there has been a significant decline in the number of certified Physics teachers in Kentucky, which mirrors national shortages (Heron & McNeil, 2016; White & Tyler, 2014).

As a part of a National Science Foundation (NSF) funded Noyce Capacity Building project aiming to inspire college-level STEM students to pursue a career in K-12 teaching, we formed a partnership with an urban science center to strengthen K-12 STEM teacher education pathways. We provided a paid summer internship opportunity at the Kentucky Science Center for STEM majors to design and implement hands-on, inquiry-based science activities with students from grade levels Pre-K through 8th grade to develop their teaching skills and interest in STEM education. Such interactions with younger students could have the effect of generating undergraduate interns' interest in pursuing a career in STEM teaching. The intention of this mixed methods study was to consider the ways in which a teaching-focused internship might impact an undergraduate STEM student's decision to consider entering the STEM teaching profession. Asking STEM interns to share their views of their internship experience, and the impact it had on their perception of teaching, gave researchers insight into additional variables which may influence undergraduate student interest in STEM teaching as a profession.

Literature Review

Interest in Teaching

Research has identified motivations people have when choosing a career in teaching that are broadly categorized as intrinsic, extrinsic, and altruistic (Richardson & Watt, 2014). The Organization for Economic Co-operation and Development (OECD, 2005) reported on studies independently conducted in France, Australia, Belgium, Canada (Québec), the Netherlands, the Slovak Republic, and the United Kingdom, which indicated that motivations for choosing teaching as a career were the desire to work with youth, the potential for intellectual fulfillment, and the wish to make a social contribution. The aspiration to work with children and adolescents has also been identified as important in many studies conducted over time in the United States (Moss, 2020), the United Kingdom, and Europe. However, we know that 'triggers' and 'drivers' to select teaching as a career can be different depending on regional context (Low et al., 2017). For example, in different sociocultural contexts, such as Africa and the Caribbean, "extrinsic motives" such as salary, job security, and career status have been found to be more prominent. Researchers seems to agree that interest can develop by having some teaching experience (Low et al., 2017).

Kyriacou and Coulthard's (2000) study on undergraduates' views of teaching as a career choice indicated that students who are seriously considering a career in teaching tend to have a much closer match of factors that are important to them and that they think are offered by teaching as a career, when compared with other students. These researchers surveyed previous studies on students' interest in teaching and found that the most motivating factors fall into three categories: altruistic reasons (e.g. desire to benefit society), intrinsic reasons (e.g. interest in subject matter and expertise), and extrinsic reasons (e.g. extended work breaks, level of pay, etc.) (Kyriacou & Coulthard, 2000). Teacher recruitment that focuses on factors influential to students who have already begun teacher training courses will inevitably miss reaching those students who are yet undecided on committing to teaching as a career. Finding an applicable means of reaching students who may have not yet even considered a teaching career was a focus of our project. We chose to examine the impact of a teaching internship on a student's consideration of the teaching profession as one possible influencing factor.

Taimalu et al. (2021) examined the influences on teaching as a career choice between students in Estonia and Finland. The researchers sought to minimize cultural differences as motivating factors and made clear from the start that both Finland and Estonia share similar cultures and courses for teacher education. However, each country exhibited very different evaluations of the teaching profession. For example, in Finland, 57% of teachers expressed that their profession is valued by society, compared to only 26% of teachers in Estonia (Taimalu et al., 2021). Although overall society between the two countries is very similar, the differences in the societies' evaluation of teaching may be attributed to the researchers' findings that in Estonia, until recently, teaching salaries were much lower than other professions. Finland has long offered adequate salaries for teachers. Estonian student perceptions of low pay may still be a contributing factor to the lack of interest in the profession. Additionally, the researchers proposed that career choices were more individually-motivated in Finland as opposed to Estonia, where a lower societal view of teaching may hinder students' interest in the career.

Australian public schools have suffered from a similar drought of qualified STEM teachers, similar to many places in the United States. As a result, the Office of the Chief Scientist launched the "Step Up Project" to stimulate interest in STEM teaching as a profession. McDonald (2017) explored the factors influencing secondary science teachers' decisions to pursue a career in teaching. Interestingly, societal factors, as discussed in the study above from Estonia and Finland, did not contribute significantly to participants' considerations. Instead, the research found that participants' experiences in high school and the lack of STEM-related jobs in other fields were the most influential

factors on their choice to pursue teaching as a career. Although the researcher acknowledged lower teaching salaries than many salaries in research-related STEM fields, the reality of a lack of jobs in those fields made the teaching profession more appealing to many of the participants. The availability of jobs, coupled with the generous time off and family-friendly work schedule, was highlighted by several participants as key factors in their choice of career.

In the United States, research has been conducted to determine promising students who may have not previously considered a teaching career. Moin et al. (2005) found that the best place to look for STEM students who may become interested in a science and/or mathematics teaching career was in their junior and senior years as an undergraduate STEM major. Surveying STEM students from two different universities to assess their interest in K-12 teaching, researchers found that students in their junior and senior year, as well as students who had mid-level academic performance, were the most promising in terms of becoming interested in a science and/or mathematics teaching career. Finally, with regard to type of major, mathematics majors were the most promising, followed by natural science majors, and engineering majors were the least promising.

Teaching Internships

Hutchinson's (2012) case study with new high school STEM teachers in the US revealed that the participants had a desire to become a teacher at very different times in their professional career preparation, and they selected different paths to enter the teaching profession. Despite information about the teaching profession not being readily available or promoted, each of the participants found ways to gain information about becoming a teacher. Beyond their recruitment, they needed support during their pre- and in-service teaching experiences. The participants referenced support and professional development activities from university mentors, mentoring from their instructional team members, support from campus leaders, and support through social networking as to what helped retain them as STEM teachers.

Regarding recruitment, Cerritos College recognized the potential impact of a STEM teaching internship on student interest in teaching. In 1999, the school developed their Teacher TRAC Program, which offers four different STEM-focused internship opportunities for STEM teachers-in-training. Parsons (2013) wrote that internship experiences are required by Cerritos College for graduation for STEM Education students, with the goal for students "to witness the application of contextualized curriculum in the classroom and create an environment of inter-disciplinary understanding" (p. 9). Our research emphasized the internship model with a critical eye to attempt to understand what factors of an internship had an impact on student perception and consideration of teaching as a career.

Borgerding's (2015) study highlighted the influence that summer internships for early STEM majors can have on student interest in teaching. Aspects of the internships such as the requirement for reflection, opportunities for teacher agency, and the balance between emphasis on classroom management and student learning were connected with interns' positive or negative teaching experiences. Furthermore, particular aspects of the interns themselves such as expectations for classroom management, a desire for authority, and interest/care for students also contributed to the impact of these internships for recruitment.

While teaching-focused internships are cited in many projects that aim to increase the interest of students who may not have previously considered teaching, the effectiveness of these internships, as far as recruitment into an education program, is debatable. From surveys of STEM students both prior to and following their summer experience, Morrell and Salomone (2017) found that very few of the interns actually did go into teaching. These researchers concluded that the internship program was not an effective use of Noyce funding to attract STEM undergraduates into the teaching profession. However, their data indicated that students did consider teaching as a viable career path sometime in

the future and ended the internship with positive views of teaching. This study suggests that the internship may have made a difference on career path choice in the long term for participants.

Still, other research points to the success of teaching internships for motivating STEM students to pursue a teaching career. For example, Mundy and Ratcliff (2021) incorporated teaching-focused internships in their Robert Noyce Summer Internship program for STEM students. Surveys of students indicated that the interns were satisfied with the Noyce Summer Internship Program, and some STEM majors or Noyce Interns decided to pursue a teaching certificate to become a high school STEM teacher. Researchers thereby contended that STEM students' interest in teaching in a STEM area increased because of the Noyce Summer Internship Program (Wong-Ratcliff & Mundy, 2019).

Methods

Internship Experience at the Kentucky Science Center

We formed a partnership with our regional Kentucky Science Center (KSC) to allow for internships that might inspire STEM students to pursue a career in STEM teaching. The KSC is a non-profit organization and hands-on science museum with an attendance of more than half a million people annually. In addition to the main gallery, the KSC has a number of hands-on exhibits such as sensory and magnet walls that offer ample experiences for experimentation. There is a MakerPlace exhibit that has a variety of skill-building activities with tools and is staffed with STEM professionals and interns who provide help and ask/answer questions. Additionally, there is a Discovery Gallery (a Natural History gallery) where students learn about anthropology, archaeology, and paleontology. There is also a curated collection of specimens, gems, and fossils. The KSC has an exhibit on NASA's second human space flight program and a Challenger Learning Center, where visitors can learn about the universe and space exploration. The Learning Center has a space mission simulation which shows how to solve real-world problems. Visitors can practice the skills utilized by the astronauts, scientists, and engineers who ensure each space mission's success.

The KSC's mission is to advance the statewide science literacy, encourage people of all ages to explore science in everyday life, and to reach all audiences through its mission to do hands-on science in ways that are engaging, educational, and entertaining. The KSC hosts numerous STEM summer camps and programs throughout the year for elementary, middle, and high school students. The KSC also holds a Youth Science Summit, which is an immersive, full-day workshop for middle and high-school students aiming to empower young adults into the STEM fields. The Youth Science Summits give high school students the chance to interact with and learn from industry professionals and faculty in academia. The KSC's educational methodology, practiced in all of its STEM-based summer camps and internship programs, uses problem-based learning methods focused on the science and engineering practices of the *Next Generation Science Standards* (NGSS, 2013*)*, thus helping students understand and implement best practices in STEM education. The KSC's summer camp internships are designed to immerse learners in inquiry-based exploration of STEM topics that are based on a relevant, real-world context that increase students' levels of interest and motivation in science. While not a replicate of a formal classroom, the standards-based focus and inquiry teaching practices emphasized in the summer camps provide a teaching and learning environment in which our interns could try out developing, implementing, and assessing lessons alongside experienced educators. Furthermore, our interns had the opportunity to learn how to manage large groups and build relationships with learners.

Funded by our Noyce Capacity Building grant, ten STEM students majoring in STEM fields took part as interns at a four-week summer camp experience (ranging from Pre-K to Grades 8) at the Kentucky Science Center so they could develop their skills in STEM education. We recruited the interns by sending out a position description to the Biology, Chemistry, Biochemistry & Molecular

Biology, Physics, and Mathematics departments at our university. Each student selected for the internship worked on average about 25 hours per week at the science center and received a stipend of $1000 for their internship, $500 as a housing stipend, and $368 towards food expenses. Interested STEM majors were asked to apply by providing a resume, statement of interest, and faculty recommendation. Of the 22 applicants, ten were selected based on GPA, experience working with youth, and faculty recommendation.

Once selected, interns were given a choice as to what grade level and content focus areas they were most interested in working with at the science center's summer camps. There were thirty summer camps offered to various grade levels ranging from PreK to Grade 8. These summer camps were called Planes, Trains and Automobiles, Cool Chemistry, Scales and Trails, Snowmen in Summer, Waterworks, Lego Design Challenge, Tall Tales, Wild By Design, Journey to Space, Speedometry, Once Upon a Design, Lego Robotics 2.0, Inventor's Lab, Matter Mysteries, Pokémon Science, Engineer Your World, Uniquely Human, Agents of STEAM, Magical Creatures, Code-Games-Create, Medical Mysteries, Lego NXT, Candy Chemistry, Animation Creation, Chemistry, Destruction Engineering, EV3 Robot Challenge, Virtual Reality, and Space Technologies.

Each summer camp was a week in duration, and each intern took part in at least three separate summer camps in order to diversify the content and grade level of their internship experience. Each applicant underwent a screening process and background check with the science center as part of their formal hiring process (all student applicants selected successfully passed this screening). Upon official hire, the ten interns completed training in preparation for their camp that was provided by the Science Center's experienced educators, which included inquiry-based teaching methods and classroom/materials management tutorials. Then, under the guidance and supervision by a science center staff member, interns facilitated all lesson plans provided by science center for up to 25 students in each summer camp class. Interns aided camp teachers by providing classroom management and guided instructional time. The interns used the engineering design processes, inquiry-based learning, and *Next Generation Science Standards* (NGSS, 2013) to conduct the summer camps and were given ongoing pedagogical support from certified educators who worked at the science center.

Demographic Information of Interns

The interns were selected from students within one of five STEM academic majors at a private Catholic university (i.e. Biology, Mathematics, Chemistry, Physics, and Biochemistry & Molecular Biology). Of the ten interns selected from a pool of interested applicants for this four-week summer internship at the science center, six interns (60%) were female and four (40%) were male. Regarding academic major, four were Biology students, two Chemistry students, two Physics students, and two Biochemistry & Molecular Biology students. Out of the ten interns, three were Freshman, four Sophomores, one Junior, and two graduating Seniors. Among the ten students, eight students were White (five were female and three were male), one student was Hispanic (male), and one student was Asian (female). Out of the ten interns, three indicated/expressed an interest in a teaching career as a high school teacher. The mean GPA of the interns was 3.35 and all had some experience working with youth in the area of tutoring specifically.

Data Collection and Analysis

The researchers utilized surveys, semi-structured interviews, and observational teaching assessments to collect data on participants' experiences before, during, and after the internship at the KSC. The interns took part in surveys and interviews conducted by researchers and by KSC staff educators that were collectively used to determine their interest in pursuing a career in STEM teaching. Interns were asked open-ended questions regarding their experience in the internship in the form of

a survey and in interviews (see Appendix A). Additionally, the science center summer camp supervisors conducted a quantitative and qualitative assessment of each student intern's performance at the summer camp (see Appendix B) using an evaluation tool common to their organization. Interviews were audio and video recorded and findings were triangulated with field notes written by the research assistant during the interviews. Science center staff also completed additional questionnaires related to their perceptions of our STEM majors' involvement in the internship. Following the completion of the study, the researchers analyzed all survey, interview, and observational data to determine interns' interest in pursuing a career in STEM teaching.

Quantitative data analysis was conducted on survey results collected by the research assistant. Qualitative analysis was conducted by examining frequencies of phrases and concepts amongst the group of interns both in surveys and interview transcripts. Researchers first coded the data independently and then came to consensus to categorize the codes thematically. Themes were then sorted into groups of positive and negative opinions about teaching. Member checking was conducted with interns to verify analysis. This thematic analysis revealed trends corresponding to interns' positive or negative perceptions about entering the STEM teaching profession and their positive or negative experiences as interns in the program. Qualitative analysis was used to triangulate variables that may impact interns' interest in teaching.

Findings

Results from Survey and Observational Data

Below we discuss the findings of key points of the survey data looking at the question of whether the internship motivated participants' interest in a teaching career and what factors influence that interest. We chose to focus our analysis on three areas: 1) Career interest of interns in K-12 teaching after the internship experience; 2) Willingness to pursue a Master of Arts in Teaching (MAT) certification if a NSF scholarship from the Noyce Program were provided for three years in the amount of $10,000 per year; and 3) Reasons for non-interest in a career in K-12 teaching. These three areas provided an understanding of interns' perceptions of entering the STEM teaching profession following their internship experience

Interns' interest in teaching at the start of the internship was 30%. See Table 1 for information on participants' interest in teaching.

Table 1

Interns' Pre and Post Interest in Teaching

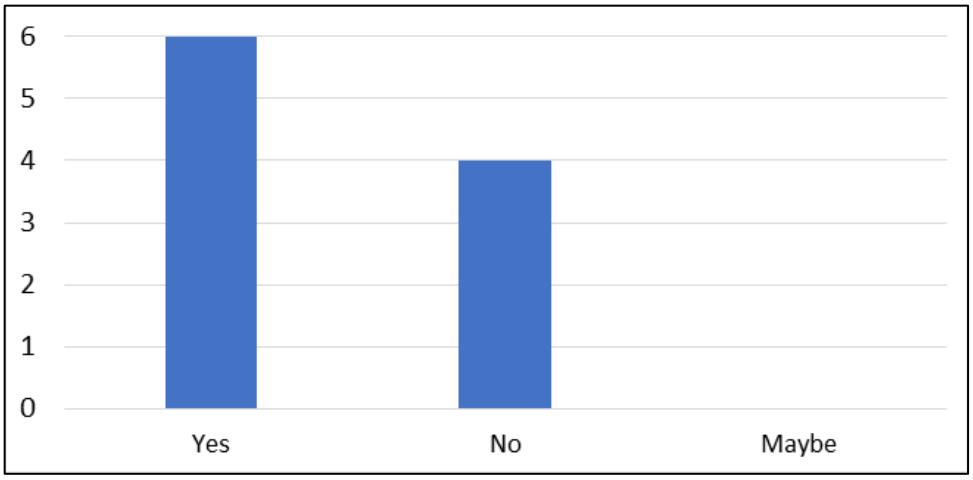
Gender	Major	GPA	Year	Career Choice	Interest in Teaching (pre/post)
Male	PHYS	3.00	Senior	PhD in Appl. Physics	Y → Maybe
Male	BMB	3.81	Freshman	Pediatric Dentist	Y → Maybe
Male	CHEM	3.58	Junior	MS. In Chemistry	N
Male	PHYS	3.46	Sophomore	Astrophysicist	N → Maybe
Female	BMB	3.44	Sophomore	Public Health	N
Female	BIO	3.46	Senior	Genetics	N → Yes
Female	CHEM	3.50	Freshman	Ph.D. Chemistry	N
Female	BIO	3.60	Sophomore	Physician	N
Female	BIO	3.15	Sophomore	Pediatric Oncologist	N → Yes
Female	BIO	3.17	Freshman	Physician's Asst.	Y → Maybe

The final column shows the pre and post interest of the interns in K-12 teaching after their completion of the KSC internship. Some of the interns who began with an interest in teaching waned, while others who had no interest became interested in teaching after the internship.

We had a rather surprising response from the interns in the survey question – "If you were offered a scholarship in the amount of $10,000 in your Junior Year, $10,000 in your Senior Year, and $10,000 towards your teacher certification tuition expense, would you consider obtaining a high school teaching certification for a teaching career at a high school," six of the ten (60%) interns stated as "Yes" and 4 stated as "No" (40%). Figure 1 is a bar chart that shows the responses of the interns regarding their interest in pursuing the MAT Teaching certification degree if a scholarship were provided for the three years (Junior, Senior and the fifth MAT year).

Figure 1

Impact of Scholarship on Consideration of Pursuing MAT Teaching Degree

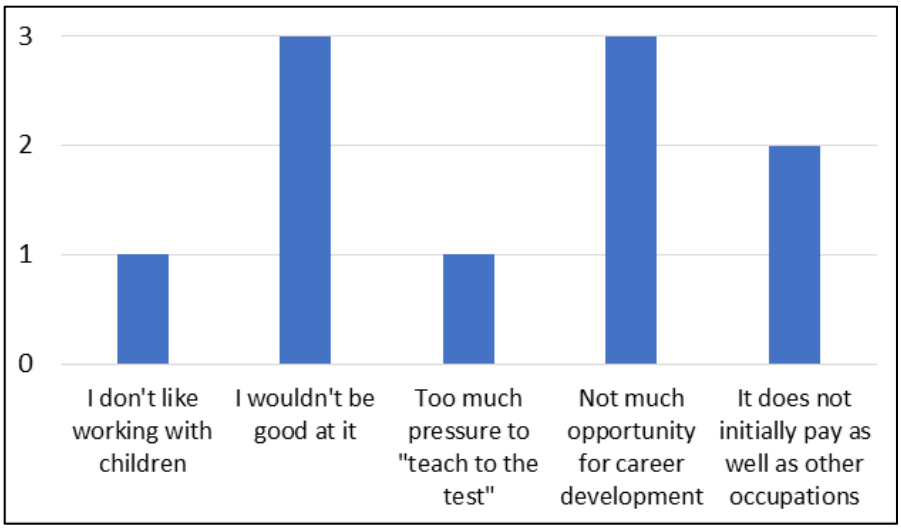


The interns' responses to this question are quite encouraging that scholarships can be an incentive for some STEM students to obtain a high school teaching certification for a K-12 teaching career at a high school.

Regarding intern reasoning for non-interest in teaching, we found a bias against the teaching profession based on perceived low wages and lack of opportunities for career development. Interns had exaggeratedly low perceptions of teacher salaries, and thus did not seriously consider teaching as a viable profession. Figure 2 shows the responses from all the interns. The top two responses were - "I wouldn't be good at it" (30%); "Not much opportunity for career development;" (30%) and "It does not initially pay as well as other occupations" (20%). Additionally, we asked "In what ways did your perceptions of teaching change during the internship?" We had varied responses; some were positive and some negative. We were particularly happy to get a rather encouraging response from one of the interns: "It went from something I never even considered as a career route to something I'm really looking into." The rationale behind this change in perceptions is explored further below with qualitative analysis of interns' responses to post-internships interview questions.

Figure 2

Reasons for Non-Interest in a K-12 Teaching Career



Observational Assessment Results

The staff supervisors at the KSC conducted evaluations of the interns and provided the summative results to interns at the end of their internship. The KSC staff of experienced educators are trained to use the evaluator instruments, and all interns are evaluated with this observational assessment . If interns have a low score (i.e. below 2.5) during these observations, formative supports would be instituted to help guide the interns. The results from the observational assessment of the interns focused on facilitation skills, including their interpersonal and communication/interaction skills. Student performance (Facilitation Skills) based on 12 separate parameters were rated on a scale of 1 - 5 (5-Outstanding, 4-Exeeds Expectations, 3-Meets Expectations, 2-Below Expectations, 1-Unsatisfactory). The results from the Facilitation Skills performance rating for the interns were used to gauge potential for how well students might do as K-12 teachers (to the extent these skills are transferable to a formal classroom environment) and interact with the younger students. This data shows that the vast majority of the ratings of each question were 4.0 or above and most ratings on the individual questions were at a 4.0. As shown in Table 2, the mean Facilitation Skills performance rating (based on the cumulative mean rating of 12 questions) of the interns ranged from 3.6 – 4.4 (out of a max. rating of 5.0), and the mean rating of each question also ranged from 3.7 – 4.3 (out of a max. rating of 5.0).

Figure 3 shows the distribution of each intern's facilitation skills performance ratings as a scatter plot. This figure shows that most of the interns scored above a 3.0 on each question of the Facilitations Skills performance rating. The interns scored the highest mean rating of 4.3 in question 5 (Is Courteous and Respectful to All Students and Staff), question 10 (Comfortable with Grade Level Content), and question 11 (Any Additional Content Provided from College Degree in STEM). All of the interns exceeded expectations in rating in questions 5 and 10, while 80% of the interns exceeded expectations in question 11. The interns scored the lowest mean rating of 3.7 and 3.8 in questions 9 ("Reads" Student Level of Engagement Effectively and Adjusts Facilitation Accordingly) and 7 (Confident in Engagement) respectively. It is understandable that interns scored somewhat lower in questions 7 and 9 compared to the other questions since this was their first experience participating in an internship in STEM education at various grade levels ranging from Pre-K to Grades 8. Even

though the mean rating of questions 7 and 9 was above 3.0, in question 7, 90% of the interns (9 out of ten) either met or exceeded expectations (out of these 9 interns, 7 exceeded expectation), while only 10% (1 intern) scored below expectation. In question 9, all (100%) of the interns either met or exceeded expectations with six of these ten interns exceeding expectations.

Despite being the first time any of these interns participated in an internship of this nature, the overall mean performance ratings of most of these interns were high for teaching in an informal classroom setting. Therefore, we concluded that these STEM students would be well suited to pursue a career as a K-12 STEM teacher and learn through a teacher preparation program to translate their teaching skills to a formal classroom setting.

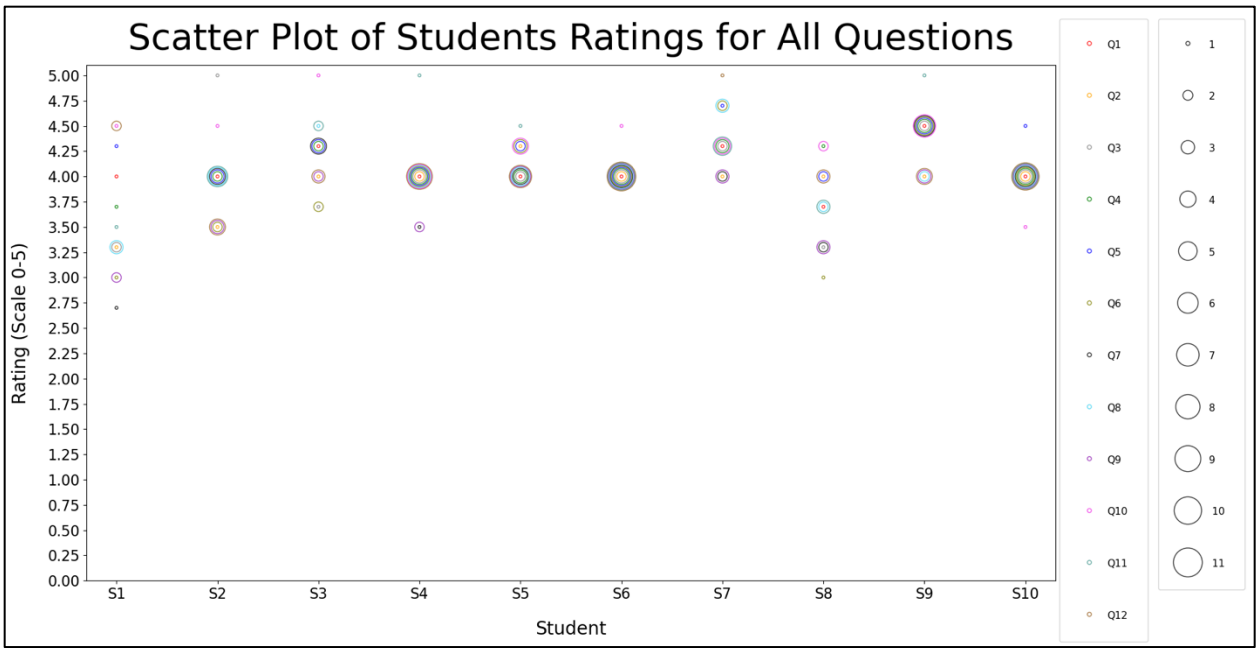
Table 2

Facilitation Skills Performance Data of Summer Camp Interns

Facilitation Skills Performance Questions	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**Mean Rating for Each Question**
Q.1: Follows Science Center Rules and Policies.	4.0	4.0	4.3	4.0	4.0	4.0	4.3	3.7	4.5	4.0	**4.1**
Q.2: Encourages Campers to Participate and Interact in Activities.	3.3	3.5	4.0	4.0	4.3	4.0	4.0	4.0	4.0	4.0	**3.9**
Q.3: Allows Students to Take Control of Learning But is There to Assist with Guiding Questions.	3.3	5.0	3.7	4.0	4.0	4.0	4.3	3.3	4.5	4.0	**4.0**
Q.4: Projects Positive Image and Attitude about STEM.	3.7	4.0	4.3	4.0	4.0	4.0	4.3	4.3	4.5	4.0	**4.1**
Q.5: Is Courteous and Respectful to All Students and Staff.	4.3	4.0	4.3	4.0	4.3	4.0	4.7	4.0	4.5	4.5	**4.3**
Q.6: Is Motivated and Takes Initiative.	3.0	3.5	3.7	4.0	4.3	4.0	4.7	3.0	4.5	4.0	**3.9**
Q.7: Confident in Engagement.	2.7	4.0	4.3	3.5	4.0	4.0	4.0	3.3	4.5	4.0	**3.8**
Q.8: Makes the Classroom a Fun Learning Environment.	3.3	4.0	4.5	4.0	4.0	4.0	4.7	3.7	4.0	4.0	**4.0**
Q.9: "Reads" Student Level of Engagement Effectively and Adjusts Facilitation Accordingly.	3.0	3.5	4.0	3.5	4.0	4.0	4.0	3.3	4.0	4.0	**3.7**
Q.10: Comfortable with Grade Level Content.	4.5	4.5	5.0	4.0	4.3	4.5	4.3	4.3	4.5	3.5	**4.3**
Q.11: Any Additional Content Provided from College Degree (STEM).	3.5	4.0	4.5	5.0	4.5	4.0	4.3	3.7	5.0	4.0	**4.3**
Q.12: Navigate Content Delivery Through Conversation Rather than Lecture.	4.5	3.5	4.0	4.0	4.0	4.0	5.0	4.0	4.0	4.0	**4.1**
Mean Cumulative Rating for Each Student (Scale: 0.0 - 5.0)	**3.6**	**4.0**	**4.2**	**4.0**	**4.1**	**4.0**	**4.4**	**3.6**	**4.0**	**4.0**	

Figure 3

Scatter Plot of Interns Ratings for All Questions



Qualitative Analysis Findings

We conducted post-internship interviews with the interns to further explore their perceptions of K-12 STEM teaching as a potential career. Six participants were interviewed in person. These audio/video interviews were recorded using the research assistant's iPhone and transcriptions were written in Microsoft Word on the research assistant's computer based on the recordings. Four participants were unable to be interviewed in person; instead, recorded interviews were conducted for those interns. Phone interviews were not recorded, but were transcribed by hand during the interview process. Field notes created by the research assistant were also written during all interviews. Transcriptions from interviews were coded to identify common themes in participants' responses. Written data were chunked into common themes of response regarding interns' perceptions of their experience. At times, interns used the same or similar words or phrases such as "challenging" or "low pay," while at other times, different words or phrases such as "rewarding/fulfilling" or "inadequate/couldn't do it" were used. After themes were established, they were organized into positive and negative categories. Two positive themes: 1) sharing a passion for STEM content between intern and student, and 2) student and intern personal growth, and two negative themes: 1) concerns about classroom management, and 2) a lack of interest in the students, were identified prominently in the interview data.

Sharing Passion for Content

Interns reported their positive emotional response when the students understood the material being presented. Interns described the campers' responses as "lighting up" and "getting excited." Multiple interns shared experiences in which the campers naturally engaged in learning activities that were of shared interest with the interns. Experiments involving the dissection of a brain and a cow's eye were mentioned, along with third grade campers discussing the physical laws and limitations of

black holes with one intern. Interns shared surprise and excitement that campers were interested in complex scientific concepts. Interns also shared their feelings of connection with the campers through their common interest in the STEM subjects. Interns' favorable responses to campers' passion for science topics informed us that interns' positive interactions with the campers may influence interns to consider pursuing their own passions for science in the classroom.

Personal Growth

Another positive theme was the interns' own reflections of personal growth in their ability to learn how to explain difficult concepts to the campers. One intern confided,

> This internship opened my eyes to difficulties of teaching, but also how much of an impact teachers can have on the lives of students. I learned how to communicate with people who are not on my same level of knowledge on a subject (Intern 5).

Another intern shared that "the internship taught me how to adapt to all kinds of situations with a variety of knowledge. I had to deliver a variety of knowledge in a truthful, but basic way, and with activities and explanations" (Intern 6). One intern shared that prior to his experience at the KSC he had never worked with such young students before. Intern 2 had the perception that "early elementary kids were just babies, but they are actually little people." This revelation of the complexity of younger learners' thoughts and engagement was affirmed by other interns as well. Having their previous perceptions of teaching challenged and changed was received as a positive experience by the interns. Additionally, interns expressed that knowing earlier in their academic career the prospects for entering into a graduate degree program (MAT degree) and becoming a STEM teacher would have made a positive impact on their interest in entering the teaching profession.

Ultimately, positive responses to participating in the internship indicated interns' perceptions of entering the STEM teaching profession were impacted favorably overall. For example, when we interviewed the interns, two out of ten who responded as "Maybe" in regards to considering the STEM teaching profession on the survey expressed they did actually have an interest in pursuing a K-12 teaching career as an option. One of these interns, who was interested in the field of genetics, indicated she was interested in teaching in the future, and confirmed the transformative nature of the internship experience. The other intern, who was interested in pediatric oncology, decided to enroll the following semester in another education-related internship in which she could work with high school students. She also stated that she had plans to enroll in the MAT program.

Concerns about Classroom Management

One recurring negative theme obtained from the interns' interview data was their dissatisfaction with the behavioral issues of some of the campers. Almost all interns mentioned the difficulty with managing the summer camp classroom. A specific instance of classroom management was shared by one of the interns:

> I was in charge of teaching kids the structure of DNA using candy. I was already nervous before we started. Throughout the entire lesson the kids didn't listen, someone was always trying to eat the candy, someone was always on the verge of crying… I felt bad because I just couldn't make it work (Intern 3).

The struggle for this intern was found in attempting to teach and explain-a complex scientific concept - in this case the structure and function of DNA - while also attempting to keep the all the summer camp participants engaged and focused in that module.

Intern 6 shared his perception going into the internship: "I knew [teaching] was time management a lot, and difficult… the internship confirmed these perceptions." A high-anxiety element of the internship experience for several interns was the large number of campers. Finding the ability to keep campers in the large summer camp classrooms engaged proved to be a challenge for several of the interns.

Lack of Youth Interest

An additional negative theme that emerged was the perceived lack of interest in some campers and the interns' struggle with trying to keep them engaged. It is probable that these two negative themes are related. Intern 9 stated that the internship had opened her mind to the possibility of becoming a teacher, sharing: "I enjoyed going to work. My last week I had a huge, wild group of kids. Some groups were really good, others not so much. There are just highs and lows of working with kids for extended periods."

This reporting contradicts the positive finding of some campers' interest in science subjects. These two perceptions offered by the interns are not necessarily mutually exclusive and may even be demonstrated by the same campers on different days, or in relation to different science topics. The interns' lack of previous teaching experience likely led to internalizing and personalizing the campers lack of interest and contributed to a sense that the intern may not be cut out to be a teacher. A lack of interest on the part of the camper correlates to difficulty in classroom management. A camper who is bored will act out in ways which make it difficult for the teacher to effectively continue teaching the rest of the class. The concern about classroom management discussed above is perhaps correlative with a lack of interest.

Discussion

The ten STEM interns who took part in the internship at the KSC's STEM summer camps acquired valuable training and experience. The interns carried out hands-on engaging science activities with Pre-K through 8th grade campers that developed their skills in STEM education. The interns used the engineering design processes, inquiry-based learning, *Next Generation Science Standards* (NGSS, 2013) to conduct these summer camps. The internship was a positive experience for the STEM students, and it increased the interest of several students in the teaching profession, with two of the ten students indicating and initiating plans for pursuing education.

Intern responses showed that the availability of Noyce scholarships would potentially be a motivating factor for some of the STEM students to obtain a teaching certification for a K-12 teaching career. Additionally, interns expressed that knowing earlier in their academic career the prospects for entering into a graduate degree program (MAT degree) and becoming a STEM teacher would have had a positive impact on their interest in entering the teaching profession. As Hutchinson (2012) found, teachers come into the profession from many different points, but knowing about the option for teaching early on is important in the recruitment process.

As stated in the post-internship interviews, several interns indicated that knowing about the options available in STEM teaching earlier in their academic career may have given them reason to consider a career in K-12 STEM teaching. However, these interns felt that they had gone too far in their academic pursuits in their respective STEM fields to change course. From this, we can conclude that having knowledge and internship opportunities in STEM education earlier in their academic career may also have an impact on their interest in a career as a K-12 STEM teacher. Offering an

internship experience in STEM education in the students' first or second year of their undergraduate STEM degree might be optimal in order to cultivate an interest in pursuing an academic career as a K-12 STEM teacher. This is important given the research about recruiting students in their junior or senior years (Moin et al., 2005); allowing students opportunities for teaching in their earlier degree pursuits (i.e. freshman and sophomore years) might contribute to more firm decisions to add an MAT degree in their junior or senior year.

Staff from the KSC indicated a desire to continue this NSF-funded summer internship program as they were impressed by the STEM students' work ethic and eagerness to learn. Interns also acknowledged that they were surprised at learning that they were better at working with younger students than they originally perceived themselves to be. This finding supports other research that suggest the relational aspect of teaching is an important factor in STEM students' desire to go into teaching (Borgerding, 2015). This was particularly noted as the explanatory cause of the change in opinion towards pursuing a career in K-12 STEM teaching by one of the interns who previously had not considered K-12 teaching as a career option. Earlier engagement and positive relationship building with the summer camp participants may be a key to encouraging STEM college students to consider K-12 teaching as a profession.

Interns' concerns about classroom management support similar research that found that more of a focus on content (over classroom management) excites more STEM students about teaching (Borgerding, 2015). We posit that feelings of inadequacy in the area of classroom management could be mitigated by taking the relevant education courses as a part of the students' core STEM curriculum in pursuit of their STEM degree. Since these students had not yet taken any education courses, they had no experience in pedagogy or best practices in inquiry-based instruction that would have supported their knowledge and skills in the area of classroom management. The KSC did provide some training in managing materials and groups, but further coursework and field experiences through a teacher training program would provide more comprehensive knowledge and skill development.

Overall, our research supports that of Wong-Ratcliff and Mundy (2019), Mundy and Ratcliff (2021), and others who have found internships to be an important recruitment tool for STEM majors to consider a career in science and/or mathematics teaching. Beyond recruitment, it is essential to continue to support developing teachers at all points of their training (prior to becoming an education major, during, and beyond into their beginning teaching) (Hutchinson, 2012). Future research is important to longitudinally track interns' career choices over time to see if interns' actually did pursue a degree in teaching (even if it was not their immediate post-graduation career choice).

Implications

Various reports have expressed the nationwide growing shortage of STEM teachers and the challenges faced in increasing the number of qualified STEM teachers in the public schools. There is an urgent national need to improve the quality of STEM education by putting well-qualified STEM teachers in high-need schools. This is so these individuals can teach STEM subjects in an effective way that may lead to more students interested in pursuing a STEM degree in college. We need to ensure that K-12 students receive the STEM training that is essential for future success. Effective STEM teacher preparation provides a vital function in pursuit of an educated and engaged populace. This project comes at a critical time for Kentucky because of the changing student demographic and the state's adoption of the *Next Generation Science Standards* (NGSS, 2013) that is undergirding a strong curriculum in STEM and the development of new statewide performance assessments aimed at improving the educational achievements for all students.

Interns shared key takeaways in their interviews regarding the variables that impacted their willingness to consider a career in STEM teaching. One of the cited reasons for some of the interns to not consider such a career move in K-12 STEM teaching was that they had already decided what

degree they wanted to pursue. In addition, the interns had already spent too much time in their academic STEM degree track and did not want to change their career pursuits at this stage. We conclude that if knowledgeable and informed STEM faculty could promote K-12 STEM teaching as a career in their STEM subjects with freshmen and sophomores, the outcome may prove different. Early exposure to internships also allows time for interested students to continue seeking education related opportunities during college, such as the student who went on to do another education-related internship with high school students. In this way, students have multiple opportunities in education to see if the fit is right for them before embarking in an MAT program.

Options in pursuit of attaining a degree in teaching with a focus on STEM education may include scholarships, accelerated programs, wrap around supports for student success, and targeted field experiences with strong mentor teachers. It is our opinion that these details should be shared with students in STEM fields early on in their undergraduate STEM degree program. Information about options and incentives such as summer internships at the KSC should not only be held as resources in academic advising offices but be readily available to interested STEM students. A forum between education and STEM faculty may need to be established in order for accurate, up-to-date information to be shared between faculty and students, especially in the area of wages and career development.

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Kristin Cook (kcook@bellarmine.edu), Associate Professor of Science Education and Associate Dean of the School of Education at Bellarmine University, received her doctorate in Curriculum & Instruction - Science Education and Environmental Sciences from Indiana University. Dr. Cook serves as a professional developer and consultant for K-12 STEAM-focused school reform and project/problem-based learning development. Dr. Cook's research focuses on engaging students and teachers with the community of science through the exploration of socio-scientific inquiry and transdisciplinary STEAM instruction.

Akhtar Mahmood (amahmood@bellarmine.edu) received his Ph.D. in Physics from the State University of New York at Albany in 1998. He is a Professor of Physics at Bellarmine University and founded the Eureka Learning Community for STEM students. He served as the President of the Kentucky Association of Physics Teachers (KAPT) from 2009 – 2012 and is currently serving as a member on the Kentucky Academy of Science's Committee on STEM Education. He was featured among the 20 People to Know in Education and Workforce Development by the Louisville Business Journal in 2017. He served as the PI of an NSF S-STEM project, an NSF Noyce Capacity Building project and is currently serving as the PI of an NSF Noyce Track-1 project.

Cody Nygard (cnygard@bellarmine.edu) is a PhD student in the Education & Social Change program at Bellarmine University. His research revolves around environmental education and connectedness to nature. Cody is an adjunct instructor at Bellarmine, as well as a high school Life Sciences teacher at Walden School, a private, non-religious K-12 school in Louisville, KY.

Mira Gentry-Johnson (mira.gentry-johnson@louisvilleky.gov) received her M.S. in Microbiology and Evolutionary Genetics from the University of Louisville in 2008 and BS in Biology from Centre College. She is the Senior Manager of Education at the Kentucky Science Center. Mira has been in informal education for 16 years.

Mellisa Blankenship (mellisa.blankenship@louisvilleky.gov) received her B.A. in Biology from Indiana University in 2009. She is the Director of Education at the Kentucky Science Center. Mellisa has been in informal education for 17 years.

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Appendix A

Survey of Interest in Teaching

Name:
Internship Focus/Topics and Reason for Choosing:
Internship Grade Levels Taught:
Current or Completed Major:
College Year: Freshman/Sophomore/Junior/Senior/Graduated/Graduate Student
Career Interest Prior to Internship:
Career Interest After Internship:
Interest in Teaching Career:
- Definitely Interested (takes you to section of Interest)
- Potentially Interested (takes you to section of Potential Interest)
- Not at all Interested (takes you to section of Non-Interest)

Reasons for Interest in Teaching
- Enjoy working with youth
- Other
- Good pay
- Job security Family members work in education
- Want others to have a better education than I had
- Great experience in my own education
- To show others how to do things
- Variety-every day is different
- Passion for a specific subject
- Inspired by my teacher(s) at school
- Want to make a difference/Give back to the community
- Other (please list)

Reasons for Potential Interest in Teaching
- Better Pay
- Learning more about what the job entails
- More opportunities for student loan forgiveness
- Less work outside of school hours
- Safer schools and classrooms
- More opportunities for college scholarships
- More prestige or respect
- More opportunity for career advancement
- More flexibility in how I would do my job
- Other (please list)

Reasons for Non-interest in Teaching
- Requires working too many hours
- There are teachers I don't like
- Lack of school resources and supplies
- I cannot be my own boss
- Too much pressure to "teach to the test"
- Teachers do not get enough respect
- I don't like working with children or young people
- I wouldn't be good at it
- Not much opportunity for career development

It does not initially pay as well as other occupations
Other (please list)

Internship experiences that contributed to your view on teaching:

In what ways did your perceptions of teaching change or not change during the internship?

Most positive aspects of internship:

Most challenging aspects of internship:

If you were offered a scholarship from NSF in the amount of $10,000 in your Junior Year, $10,000 in your Senior Year, and $10,000 towards your teacher certification tuition expense, would you consider obtaining a high school teaching certification for a teaching career at a high school for at least 3 years?

Recommendations to future Noyce interns:

Appendix B

Observational Instrument given by the Kentucky Science Center

Intern Evaluation Form - School's Out Science Camp

Intern Name: Stash Grade 1-2 Duration (15 min minimum) 4hours
Camp Name Speedometry Number of campers 11 Camp Teacher: Cana
Observer Cana Position Teacher Date/Time: July12

Please rate the Intern using the rating scale listed below:

1= **Unsatisfactory:** Performance is consistently unacceptable.
2= **Below Expectations:** Performance fails to meet position requirements on a frequent basis.
3= **Meets Expectations:** Performance is regularly competent and dependable.
4= **Exceeds Expectations:** Performance is routinely above position requirements.
5= **Outstanding**: Performance is consistently superior.

Facilitation Skills	1	2	3	4	5	Comments
Follows Science Center rules and policies with students				✓		
Encourages campers to participate and interact in activities				✓		
Allows students take control of learning but is there to assist with guiding questions.				✓		
Projects positive image and attitude about STEM					✓	
Is courteous and respectful of to all students and staff					✓	
Is motivated and takes initiative			✓			A little hesitant to initiate lessons Great help during lesson activities
Confident in engagement			✓			hesitant at first to initiate lesson but supported engagement throughout lesson
Makes the classroom a fun, learning environment				✓		
'Reads' student level of engagement effectively and adjust facilitation accordingly.			✓			
Comfortable with grade level content.				✓		
Any additional content provided from college degree (Engineering, Physics, Math, Chemistry).				✓		
Navigate content delivery through conversation rather than lecture.				✓		

Please circle the words that describe the Intern:

Adaptable	Hard worker	Lazy	Rowdy
Calm	Helpful	Negative	Rude
Disruptive	Honest	Polite	Self-Motivated
Energetic	Insubordinate	Quiet	Stubborn
Fun	Intelligent	Reliable	Team Player

Best practices observed from Intern's facilitation:

Please note any additional comments:

I think with time and a little practice he can overcome his hesitation as a class leader.

☑ I recommend this Intern for future camp programs.

☐ I do NOT recommend this Intern for future camp programs