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Science Slices:
Building Community Around STEM Enrichment

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Abstract

Middle school (ages 11-14) is a period when students – particularly female students – are vulnerable to 'becoming less scientific' [1]. Supporting middle school students' development of positive attitudes and abilities in science can help keep them engaged in science [2,3], and positive attitudes toward science are particularly important for marginalized science learners [4]. Connections between home and school can also help by promoting positive science identities [5], and family engagement is important in supporting academic success [6.7]. Science cafés are a form of informal science programming that has been shown to enhance teens' views on science [8]. Over the last three years, the Elon Explorers Science Slices science café has built community around STEM engagement through a monthly series of informal science events. These events invite participation by middle school students and their families. Each event includes a meal, a short presentation by an invited speaker, and a hands-on science activity. Over the program, engagement has increased with students and families coming from across the local region. During 2023-2024, we recorded 464 instances of engaging people with science through Science Slices (147 instances with middle school students and 317 instances with family members). More than half of the 48 unique students who participated in Science Slices during 2023-2024 attended multiple events, and one-third of these students attended at least three events. Recurring participation by students and their families suggests the development of a community and a perceived value by them. Analysis of registration surveys, exit surveys, and anecdotal notes reveals several themes. The events show impacts on improving access and engagement with science, developing students' science identities, and developing relationships between university faculty, university students, local school children, and their families.

Keywords *Informal science, identity, affiliation, science cafes*

Introduction

This paper reports on one program that is part of an on-going science enrichment project for students eleven to fourteen years of age. The project began in 2019 and has expanded meaningfully over the last five years. The project began out of concern over a perceived lack of access in the local community to academic enrichment programs – particularly a lack of STEM enrichment targeting marginalized individuals. We also recognized that there were limited resources and programs to support students in the sixth through eighth year of schooling in building enthusiasm for science and undergraduate education.

The program we focus on here, "Science Slices," is a multi-generational, family-focused program that offers a free science cafe to local families, focused on the school-aged family members who are in their middle years of education. The monthly events involve presenters sharing about a variety of STEM topics, and each one includes a communal pizza dinner and time for socializing. During the three years that this program has been offered, attendance has increased to the point that we at times have had to limit registrations. This paper reports data from the two most recent years of the program. The important outcomes are that children and their families are building community with one another and considering potential future career paths in different STEM fields.

Overview of Topic

Identity and affiliation with STEM are situated in a robust set of literature that will not be exhaustively reviewed here. However, we will consider salient research that clarifies the point of this research. We situate our thinking in the use of identity as an analytic lens for researching educational programs and experiences [9]. That perspective has already led to important insights about identity and affiliation with STEM in terms of girls [1] and minoritized individuals [4]. This has led researchers to acknowledge that to address justice, equity, diversity, and inclusion, explicit efforts are needed to engage more individuals in STEM and consider STEM careers [4, 10, 11].

Informal STEM experiences have also been investigated to the point that meta-analyses of that research have revealed themes about the benefits of informal experiences in supporting STEM identity and affiliation [10, 11]. Of interest to us, and less well described in previous research, is the role of science cafés in supporting STEM identity and affiliation. Some have argued that teen science cafés support positive STEM identity development, and positively impact career awareness and interests, as well as some increases in competency in content knowledge [8].

Science Slices – Program Description

Sixth through eighth grade students in the Alamance-Burlington School System (Alamance Co., NC) and their household members are invited to participate in monthly Science Slices events during the school year. Events are advertised through a program emailing list and the school system's social and advertising media (i.e., PeachJar). Participants register for events through a Google Form. Each event is held in a large classroom with tables that allow café style seating at a community college campus (Alamance Community College) centrally located in the county.

The presenters or Visiting Scientists for this program are recruited from regional universities, colleges, and state and federal agencies. Presenters are provided with guidelines describing the program goals, components of a typical evening, audience size and composition, and logistical information.

Each Science Slices event includes a meal and time to socialize followed by a science program. A typical science program includes a short narrative presentation by the Visiting Scientist that includes information about their background and career path, what they study, and a brief introduction to any knowledge participants need to engage in a hands-on activity for that evening.

The hands-on activity is led by the Visiting Scientist and supported by the two faculty who lead the program as well as by two undergraduate students who work with the program year-round. Participants generally sit in groups of six to eight individuals at tables, and we have seen two general formats for hands-on activities that our Visiting Scientists develop: in one model, most of the activity is conducted at the group tables, with facilitators moving among the tables to assist as needed; in a second model, presenters set up a few stations at separate tables around the room, and participants divide into that number of groups and move through the activities at each station. A list of Science Slices events including information on topic area and activity is included in Table I.

Methodology

Data Collection

Data were collected from student participants and family members at the beginnings and ends of *Science Slices* events via sign-in sheets and exit surveys, respectively. Sign-in sheets included prompts to collect the following information: the name of the student; the number of attendees in the group; the number of middle grades students in the group; demographic descriptors of the middle grades student; why the student attended the event; how the student/group learned about the event; and if the group wanted a gift card to reimburse travel to event . Exit surveys initially included two items (i.e., *How much did you enjoy tonight's event?* and *How much did you learn at tonight's event?*) and expanded to include an additional two items (i.e., *How much does Science Slices impact how you identify as a "science person"?* and *How much does Science Slices make you think about becoming a scientist?*) during 2023-2024. Student

participants wrote their names on both sign-in sheets and exit surveys, so it was possible to associate data across the two different surveys and across different *Science Slices* events.

Data Analysis

We collected and quantitatively summarized demographic data on student participants from sign-in sheets for all 15 events. We were also able to analyze exit data from 13 out of the 15 events; these data were not collected from two of the events.

Results

Participation and Demographic Data on Participants

Between November 2022 and October 2024, we coordinated 15 Science Slices events. Each event lasted for 1.5 h, for a total of 22.5 hours of programming. Topic areas of these events included life sciences (6 events), engineering, technology, applied science (5 events), physical sciences (2 events), mathematics (1 event), and computer science (1 event) (Table I). All events included some discussion of STEM identity and career path by the presenter, some lecture / explanatory component of the topic and activity, and some time spent in hands-on activity by participants.

Table I. Science Slices events from November 2022-October 2024.

Date	Event title	Topic area: subtopic
1 Nov 22	Mockingbirds Mocking Birds	Life science: Animal Behavior
6 Dec 22	Physics and Climate Change	Physical science: Physics
8 Feb 23	Generate - A game about energy use	Engineering, technology, applied science
8 Mar 23	Physiology Phun-Day!	Life science: Human Physiology
29 Mar 23	Fun with Images	Computer Science
26 Apr 23	Environmental Engineering: Nanoparticles	Engineering, technology, applied science
10 Sep 23	Building particulate matter sensors	Engineering, technology, applied science
18 Oct 23	Robotics	Engineering, technology, applied science
15 Nov 23	Human Anatomy: Bones and Backpacks	Life science: Human anatomy
13 Dec 23	Animal Adventures	Life science: Human-Wildlife Interactions
13 Feb 24	How predator-prey interactions shape populations!	Life science: Population biology
12 Mar 24	Measuring what your body does!	Life science: Human physiology
9 Apr 24	Baking Soda vs. Baking Powder... What's the difference? (A cupcake adventure into culinary chemistry!)	Physical science: Chemistry
7 May 24	Ignite: Sustainable engineering and design	Engineering, technology, applied science
17 Oct 24	Zombies Among Us: Using Statistics to Track the Outbreak!	Mathematics: Statistics

We report participation data according to programming year. From November 2022 through October 2023, we held eight events at which we recorded 350 instances of engaging people with science, as well as participation by 61 unique students and family members from 58 unique households. From November 2023 through October 2024, we held seven events at which we recorded 464 instances of engaging people with science, as well as participation by 48 unique students and family members from 47 unique households. During 2022-2023, students were evenly distributed across middle grades; during 2023-2024, we had more seventh graders participating (Table II). During both years, the three racial / ethnic identities most frequently represented among participants were White, Black or African American, and Hispanic or Latino/a (Table III).

During both programming years, a substantive number of student participants returned to *Science Slices* after attending one event. Roughly one quarter of student participants in 2022-2023 and one third of participants in 2023-2024 attended three or more events (Table IV). We note that almost half (34/72, 47 percent) of the unique student participants in our combined programs (i.e., Science Slices, Spring

Break Institute, and Bug Camp) returned in 2023-2024 after participating in one or more events in 2022-2023.

Table II. Science Slices student participant data by programming year showing participation by grade.

Grade	6	7	8	Other	Total
2022-2023	20	16	14	4	54
2023-2024	8	25	12	2	47
Total	**28**	**41**	**26**	**6**	**101**

Table III. Science Slices student participant data showing participation by self-reported race/ethnicity and gender identity.

		Gender			
Race/ethnicity	**Year**	**F**	**M**	**Prefer not to say**	**Total**
Black or African American	2022-2023	12	3		15
	2023-2024	7	6		13
Hispanic or Latino/a	2022-2023	2	0		2
	2023-2024	5	1	6	
Asian or Asian American	2022-2023	0	2		2
	2023-2024	1	1	2	
White	2022-2023	9	14	2	25
	2023-2024	7	10	17	
Another race / More than one race	2022-2023	3	2		5
	2023-2024	4	3		7
Unsure/No Response	2022-2023	1	3	1	5
	2023-2024	1	2	3	
Totals	2022-2023				**54**
	2023-2024				**48**

Table IV. *Science Slices* student participant data showing the number of students who attended one, two, three, or four or more events in each programming year.

Number of events attended					
Year	**one**	**two**	**three**	**four or more**	**Total**
2022-2023	36	11	3	11	**61**
2023-2024	20	12	6	10	**48**
Total	**56**	**23**	**9**	**21**	**109**

Impacts on Participant Enjoyment, Learning, Science Identity, and Consideration of STEM Career Paths

We report survey data from 13 of the 15 total events. Participants consistently reported that they enjoyed and learned new information at these events (Likert scores out of 5.00: Enjoyment: 4.46; Learning: 3.92 (means of medians for each of 13 events)) (Figures 1 and 2). From a subset of events, participants also reported that these events impact how they identify as a "science person" and the degree to which the events affect their thinking about science careers (Science Identity: 3.75; Consideration of Science Career: 3.5 (means of medians for each of 6 events) (Figures 3 and 4).

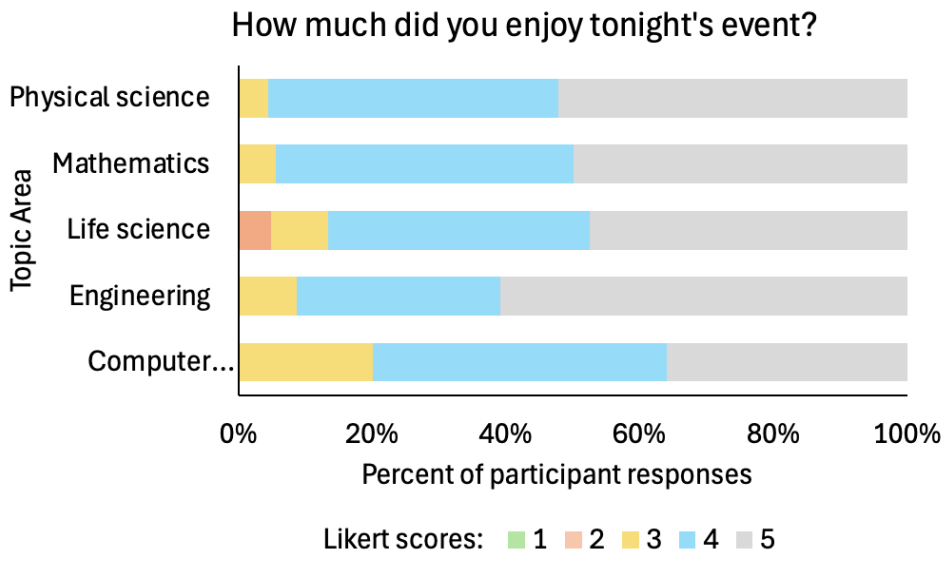

Fig. 1. Self-reported scores from participants about their enjoyment at *Science Slices* events. Data are shown from 13 events.

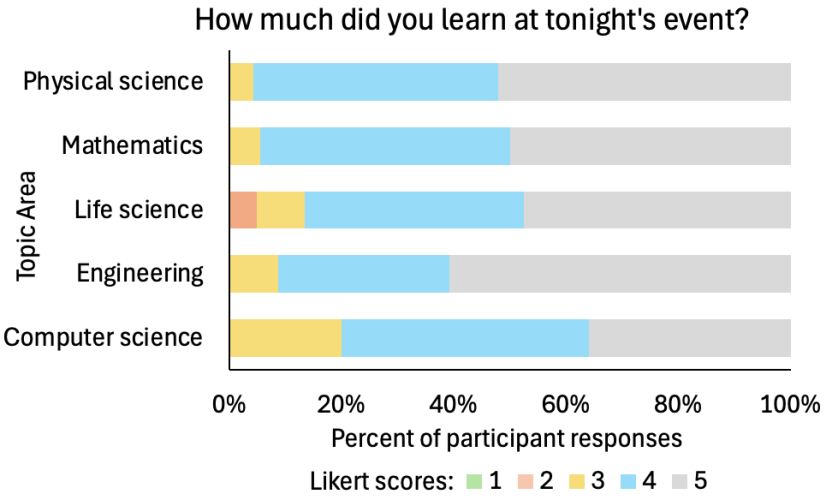

Fig. 2. Self-reported scores from participants about their perceived learning at *Science Slices* events. Data are shown from 13 events.

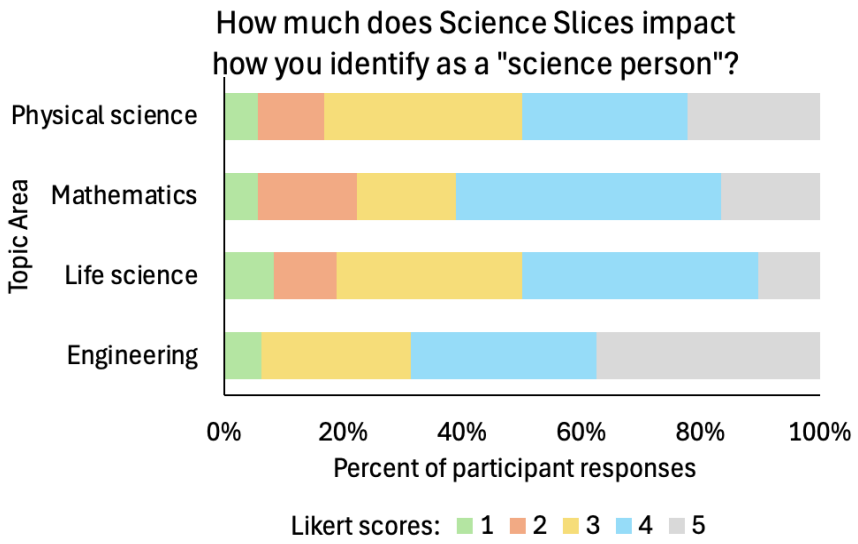

Fig. 3. Self-reported scores from participants about their perceptions of how *Science Slices* events impact their science identity. Data are shown from six events.

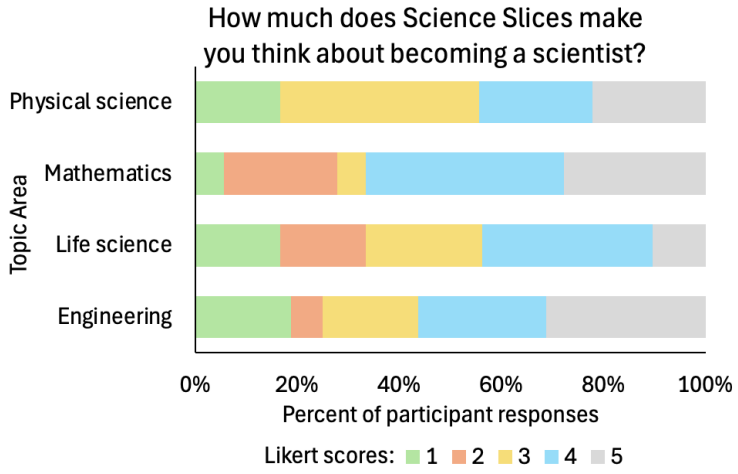

Fig. 4. Self-reported scores from participants about how *Science Slices* influences their thinking about science career paths. Data are shown from six events.

Discussion/Conclusion

A sense of identity with a discipline, with feelings of alignment or affiliation, can influence whether school aged participants engage in STEM and consider STEM careers [1,2,3, 4].

The role of informal programs such as science cafés in supporting STEM identity and affiliation is not well studied. To our knowledge, this study is the first to examine potential benefits of science cafés for pre-teens. Our findings are consistent with work by Amanova & Dymond [8] that suggests that science cafés can provide benefits for teens, including support of positive STEM identity development, positive impacts on career awareness and interests, and some increases in competency and/or content knowledge. Responses by pre-teen student participants to all four exit survey items in this study were strongly positive, indicating that participation in these events affected student learning about science, student science identity, and student consideration of science career paths.

What factors most strongly influenced student learning, STEM identity formation, and consideration of career paths? Meta-analyses of research on the effects of informal STEM experiences suggest that such experiences can support STEM identity and affiliation [11]. Likely drivers include

engagement with hands-on activities, repeated interactions with STEM topics in an informal context, meeting scientists and learning about their identities and career paths, spending social time with peers and family members while learning about science, and/or the formation of a diverse and stable community of peers and families. Each of these factors may contribute to the outcomes listed above, and further work is needed to uncover the directions and sizes of impacts. We note that many of the student participants and family members attended multiple events and even returned between years. We identify that such repeated engagement by some, but not all student participants and family members, positions us to do additional work examining the effects of repeated engagement and relationship building on development of science identity and consideration of STEM career paths.

Additionally, the limited research on teen science cafés suggests some effects related to participant race or ethnicity, but the findings are not clear on how informal programs like science cafés impact pre-teen individuals who are minoritized in STEM according to gender, sex, race, home language, or socioeconomic status. Our participant community is diverse, and we are well situated for future study examining whether student participant responses differ according to such demographic factors.

REFERENCES

[1] Carlone, Heidi B., Scott, Catherine M., Lowder, Cassi (2014) Becoming (less scientific: A longitudinal study of students' identity work from elementary to middle school science, Journal of Research in Science Teaching, 51:7

[2] Jones, M.G., Chesnutt, K., Ennes, M., Macher, D., and Paecther, M. (2022) Measuring science capital, science attitudes, and science experiences in elementary and middle school students, Studies in Educational Evaluation, 74

[3]Pei-Yi Lin & Christian D. Schunn (2016) The dimensions and impact of informal science learning experiences on middle schoolers' attitudes and abilities in science, International Journal of Science Education, 38:17, 2551-2572, DOI: 10.1080/09500693.2016.1251631

[4] Calabrese Barton, A. (2003). Teaching science for social justice. New York: Teachers College Press.

[5] Zimmerman, Heather T. (2012) Participating in science at home: Recognition work and learning in biology, Journal of Research in Science Teaching, 49:5. 597-630

[6] Bachman, Hadley F., Anderman, Eric M., Zyromski, Brett, and Boone, Barbara (2021) The role of parents during the middle school years: Strategies for teachers to support middle school family engagement, School Community Journal, 31:1

[7] Archer, Louise., DeWitt, Jennifer., Osbourne, Jonathon., Dillon, Justin., Willis, Beatrice., and Wong, Billy. (2012) Science aspirations, capital, and family habitus: How families shape children's engagement and identification with science, American Educational Research Journal, 49:5

[8] Chynar Amanova & Judith Dymond (2024) Teen participants' experiences with a teen STEM café program, International Journal of Science Education, Part B, DOI: 10.1080/21548455.2024.2351599

[9] Gee, J.P. (2000) Identity as an analytic lens for research in education. Review of Research in Education. 25:1. 99-125, doi-org.elon.idm.oclc.org/10.3102/0091732X025001099

[10] Rodriguez, A.J., Morrison, D. Expanding and enacting transformative meanings of equity, diversity and social justice in science education. *Cult Stud of Sci Educ* **14**, 265–281 (2019). doi.org/10.1007/s11422-019-09938-7

[11] National Research Council. 2009. *Learning Science in Informal Environments: People, Places, and Pursuits*. Washington, DC: The National Academies Press. doi.org/10.17226/12190.